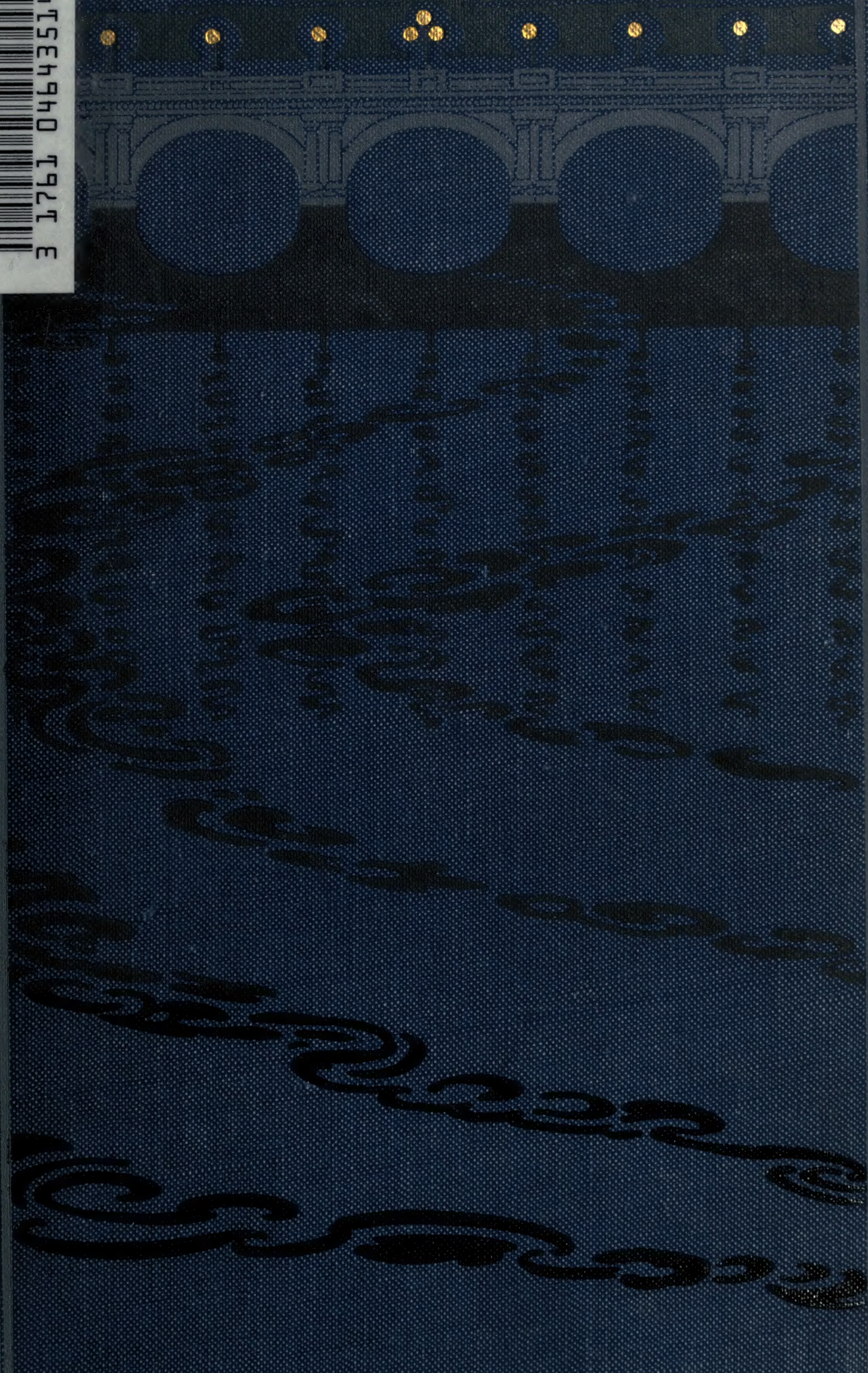
OUR WATERWAYS



OUR WATERWAYS

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A HISTORY OF INLAND NAVIGATION CONSIDERED AS A BRANCH OF WATER CONSERVANCY

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PREFACE

THE subject of the following pages is in reality but a portion of a much larger one—Water Conservancy, or the scientific treatment of all the water received in these islands, a comprehensive definition of which will be found at the commencement of Chapter III., and to the various other branches of which—Fishery, Water Supply, and the Prevention of Floods and of River-pollution—allusion will be occasionally necessary.

It had been originally intended to trace the evolution and subsequent history of each of these branches of Conservancy, as well as that of Inland Navigation, separately. It has however been felt that, in view of the growing interest in the latter subject, as evidenced by resolutions passed during the last six years at the annual meetings of the Associated Chambers of Commerce,[1] and of its

[1] One of the first of these resolutions, subsequently embodied in a memorial to Mr Chamberlain, then President of the Board of Trade, was passed at the annual meeting in London, 1882; the most recent are those passed at the Manchester meeting, 1904, and at the meeting at Liege in October of the present year. It may be added that the Marquis of Salisbury had arranged, prior to the dissolution of Mr Balfour's Ministry, to receive at the Board of Trade on 12th December deputations from the Association of Chambers of Commerce and the Mansion House Association on Railway and Canal Traffic,

importance as bearing on the maintenance of our commercial prosperity, it might be of use to those interested in it to give precedence to that portion of Conservancy which deals with the historical development and present condition of our waterways.

As regards the latter part of the subject, the authors desire to express their obligations to the eminent engineers and scientific writers whose works have furnished the data on which suggestions for a definite line of policy with respect to the resuscitation of our Inland Navigation System have been framed. They must also take this opportunity of expressing their thanks to the Society of Arts, the Institution of Mining Engineers, and the proprietors of the London Quarterly Review, for permission to make use of papers and articles by them on the subject which have been already published in the Journals and Transactions of these two Societies, and in the pages of the Review.

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which proposed to urge on him "that the improvement and development of the internal waterways of the United Kingdom and Ireland are of the utmost importance for cheapening and expediting the transit of heavy goods, and that public Canal Trusts or some other method should be adopted to create a national system of cheap inland water transportation."—*Morning Post*, 11th November, 1905.

U. A. F.
W. H. R. A.

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OUR WATERWAYS

CHAPTER I

THE OBJECTS OF WATER CONSERVANCY

Bacon's definition of rivers. No longer appreciated save by the engineering profession. Importance of rivers as shown in British, Saxon, and Medieval history. Owing to decay of Roman road system, continued to be used as highways till close of eighteenth century. Supplied motive power for mills, and machinery used in manufactures. Fisheries in rivers and lakes provided one of the chief sources of food-supply till the Reformation. References to mills and fisheries in Domesday Book and manorial records. Importance attached to rivers by the Legislature shown by Statute Roll. Legislation with respect to fisheries extends over six centuries. Provision for conservancy of navigation contained in Magna Charta. Antiquity of private Acts relating to water-supply. Causes of neglect of the subject in recent times. Evils resulting from this neglect demonstrated by numerous reports of Royal Commissions and Parliamentary Committees. Efforts of various organisations to stimulate public interest. The British Association. The Society of Arts. The Institution of Mining Engineers. The Sanitary Institute. Attempts at remedial legislation. Proposals for establishment of a central water authority. Objects of the present work.

Rivers are described by Bacon as "the richest mines above ground," and Francis Matthew, who quotes this dictum in his pamphlet on "The opening of Rivers to Navigation," presented to the king and to Parliament in 1665, compares them to "Statesmen

sent abroad." As statesmen, he says, "are never out of their way, so they pass by great Cities, Marts, Courts of Princes, Armies, Leaguers, Diets, and the like Theatres of Action ; so navigable Rivers the more places of note they pass by, the more they take up or bring, still gleaning one commoditie or other from the soyl they pass through, and are supplied, by every town they touch at, with employment."[1]

Though it will still be appreciated by engineers, this quaint encomium on our natural waterways, written a century before the making of the first canal, will doubtless, at first sight, appear somewhat exaggerated if not unintelligible to many readers at the present day. Modern inventions have so revolutionised all the details of our lives that it is difficult for us now to realise the important part which rivers have played in our history. From the time of the Britons, who used them for transporting their merchandise from the interior to the coast, our principal cities and towns have been built on their banks, and during the early part of the last century the Thames was still the "silent highway" of London. In Saxon times they were the scene of many a conflict with the Danes, who by their means penetrated to towns as far inland as Lincoln, Ely, Canterbury, and Norwich. The Thames, the Ouse, and the Trent were the principal lines of demarcation between the Danish and English kingdoms in the settlement made between Alfred and Guthrum, and rivers have, from time immemorial, successively formed the boundaries of British tribal territories, Saxon kingdoms, and modern counties. Owing to the decay of the old Roman road system, rivers had been used as high-

[1] Cf. *The opening of Rivers to Navigation*, p. 3.

ways for centuries before Matthew pointed out the advantages to be gained by connecting the more important ones by artificial means. In the eighteenth century, during the latter half of which they were supplemented by the great system of canals originated by Brindley and the Duke of Bridgwater, the facilities they afforded for transport, and the motive power for machinery supplied by their tributaries, materially contributed to the rapid progress of our manufactures. The same motive power, derived not only from tributary streams but from rivers like the Thames, was utilised for the watermills, which, though now fast disappearing, remained indispensable to agriculture till nearly the middle of the nineteenth century;[1] and one of the most important items of the national food-supply until the close of the Reformation era was provided by the extensive fisheries which existed in the great majority of rivers and lakes throughout the kingdom. The details with respect to the rents accruing from the numerous mills and fisheries then existing, which are to be found in Domesday Book, and in a long series of old manorial records, show that it was not only on account of their value for commercial purposes that rivers were regarded by our ancestors as "mines of wealth"; and the importance in which they have been always held by the Legislature is abundantly evidenced by the Statue Roll. Magna Charta is the first, and the Salmon and Freshwater Fisheries' Act

[1] The importance of these mills in former times is shown by the fact that of those on the Wandle, a tributary of the Thames, which have been some of the best in England, one was built by Smeaton and another by Rennie. See remarks by Mr Gibbs during a discussion on a paper read before the Institution of Civil Engineers by F. Braithwaite, M.I.C.E.; *Proceedings*, vol. xx., p. 212.

1892 the last of a series of statutes, covering a period of over six centuries, now in force with respect to inland fisheries. The first Act, dealing with the prevention of floods, was passed in 1428. Both the Thames—which, however, was not made navigable from Bercot to Oxford till three centuries later—and the Medway are especially mentioned in Magna Charta in connection with the destruction of weirs which impeded navigation, and the first Act relating to the Severn was passed in 1431. The long series of private and local Acts, relating to inland navigation and water-supply, date back, as regards the former subject to 1423, and as regards the latter to 1541, and numerous general statutes with respect to both have been passed within the last fifty years.

Despite this abundant legislation there can be little doubt that the importance of utilising and developing our waterways is not generally realised. This may perhaps in some measure be due to the influence of modern civilisation, which, by accustoming the individual to depend on the State and local authorities for the supply of all his wants, renders him indifferent to the value of the natural resources of his country. It is, however, also largely attributable to the facts that Parliament in legislating on the subject has dealt with navigation, fishery, and water-supply separately, and without regard to the capacity of our water system considered as a whole ; and also that the results of its legislation for other objects have proved injurious to each of these branches of water conservancy. While it has vitally impaired the efficiency of our inland navigation system by allowing the greater part of it to pass into the hands

of the railway companies, it has also permitted—or rather it in the first instance compelled urban authorities to use our rivers as sewers by the establishment, under the Public Health Act 1848, of the system of sewer drainage in lieu of that of cesspools, and at the same time encouraged manufacturers to increase their pollution by authorising them to use the local drainage systems for the discharge of their refuse.

The demonstration of the evils resulting from this policy by numerous Parliamentary and Departmental Committees and Royal Commissions has produced a certain amount of remedial legislation on the subject which has, however, hitherto yielded little or no results, though various societies and organisations have constantly endeavoured to stimulate public interest with regard to it.

One of the earliest and most important steps in this direction was the discussion, by the "Rivers Section" at the meeting of the British Association in Dublin in 1878, of the science of water conservancy by eminent engineers and scientific authorities, whose proceedings were subsequently published in pamphlet form.

Of the various branches of this science, inland navigation, with respect to which a select committee of the House of Commons collected much valuable information, and made important recommendations in 1883, has been the subject of two Conferences, of which the first, organised by the Society of Arts, was held in London in 1888, and the other met in Birmingham under the auspices of the Institution of Mining Engineers. It has also been thoroughly discussed at various meetings of the

Institution of Civil Engineers, while its condition in this country has been also dealt with in papers read before the International Congresses on Inland Navigation, which have been held periodically during recent years, and one of the latest of which met in Manchester. The question of water-supply, which since 1821 has been investigated by *nine* Commissions and *eleven* Parliamentary and Departmental Committees, has also been extensively examined at a series of Conferences convened by the Society of Arts during the years 1878-80, as well as by numerous others of the principal learned societies; and a more recent illustration of the importance it is assuming is to be found in the representation of the County Councils' Association, the Sanitary Institute, the British Association of Waterworks Engineers, and the Underground Water Preservation Association on a deputation to the President of the Local Government Board in October 1902, with respect to the depletion of our sources of water-supply. The renewal of public interest in fisheries has led to the appointment of Commissioners of Salmon Fisheries in 1865, the extension in 1878 to freshwater fisheries of the provisions of the Salmon Fisheries' Acts, and the appointment of the Salmon Fisheries' Commission, 1902, to investigate the working of the present system and the effects of pollution on salmon rivers. In some of the northern counties joint committees of county councils, constituted under the Local Government Act 1888 and local Acts, have also begun to deal with the question of river pollution, which the Rivers Pollution Prevention Act 1876 has proved powerless to check, and it is also being now investigated by the Royal Com-

mission on Sewage Disposal appointed in 1898, which has already published three or four reports. Lastly, both this Commission and that of 1902 on Salmon Fisheries—the report of which contains valuable evidence and suggestions with respect to the diminution of the volume of rivers owing to the abstraction of their sources of supply by water companies—have concurred in recommending the establishment of a central Water Authority, with subordinate boards for each watershed, for controlling salmon fisheries, and preventing the pollution and injurious abstraction of water from rivers. This recommendation, coupled with the opinion expressed by the Commission of 1902 that the time has arrived when the Government should cause a survey and estimate of the water supplies available in all watersheds throughout the kingdom to be made for the use of the proposed watershed boards,[1] practically amounts to a proposal for the establishment of a department of water conservancy—a suggestion which, it may be noted, is identical with one previously made by Mr Easton, the President of the Rivers Section, at the Dublin meeting of the British Association, 1878, already referred to.

It is therefore evident that a large body of those who have most carefully studied the subject are of opinion that the scientific treatment of our

[1] *Report*, pp. 12, 49-51, 61. The suggestion that a State record of the surplus water flowing from high and uncultivated lands should be regularly kept, was made in a paper read by Mr Charles Slagg, C.E., before the Congress of the Society of Arts on Water-supply, Sewage, and Health, held in 1878 (*Report of Proceedings*, p. 112 *et seq.*); and a hydrogeological survey of England was advocated at the meeting of the British Association in 1878 by Mr Joseph Lucas, F.G.S., in a paper on that subject (*Proceedings*, vol. xlviii., p. 692).

water system is a question which, in view of the increase of our population, and the growth of manufactures, is well deserving of the attention of the State; and it is the object of the present work to endeavour to further the ventilation of that question by supplying the general reader with the information required for enabling him to form an opinion with respect to it. It is therefore proposed, after a brief description of the water system of the United Kingdom and of the conditions under which the development of the uses of water—navigation, fishery, and water-supply—and of the machinery adopted for checking the evils—floods, pollution, and waste—resulting from its misuse have hitherto been conducted, to consider in detail the history of the conservancy of navigation and the proposals for uniting the three great branches of water conservancy under a single authority.

CHAPTER II

THE WATER SYSTEM OF THE UNITED KINGDOM

Definition of water conservancy. Definition of a water system. Water-supply of a country largely determined by physical features, geological characteristics, and climate. Rainfall. Depends mainly on direction of prevailing winds. Drainage areas, water-partings, and watersheds. Characteristics of water system of the United Kingdom. Average rainfall in the three kingdoms. Superior advantages possessed by the British Isles with respect to tidal rivers and tidal coast line. The river system of England and Wales. Of Scotland. Of Ireland. Changes due to natural phenomena, and the progress of civilisation. Uses of rivers and objects of their improvement and regulation.

WATER conservancy has been defined by the eminent engineers who discussed the subject at the Dublin meeting of the British Association in 1878, referred to in the last chapter, as "the scientific treatment and regulation of all the water received in these islands from its first arrival in the form of dew or rain till its final disappearance in the ocean."[1] In other words, water conservancy aims at the utilisation by scientific methods of the whole water system of the country, and before proceeding to trace its

[1] By Mr Edward Easton, C.E., President of the Mechanical Section. See *Proceedings*, vol. xlviii., p. 679; and *cf.* a paper by Sir J. Clarke Hawkshaw, M.I.C.E., read at the Congress convened by the Society of Arts on Water-supply, Sewage, and Health in May 1878; *Proceedings*, p. 101.

development, it is necessary to explain what is meant by the term "water system," both generally and with special reference to these islands.

Broadly speaking, the water system of a country may be said to comprise both all the water accumulated *upon its surface,* whether in the form of springs, brooks, rivers, artificial water-courses, lakes, ponds, or pools, and all the water hidden *beneath it*, whether flowing in a well-defined channel, or merely percolating through the soil. And it is important to remember that the volume of the springs and water-courses, the size and direction of the rivers, and the amount and locality of the supplies of subterranean water, are all alike dependent on the physical features and geological characteristics of the country which, in conjunction with its climate, also determine the amount of water it receives from the clouds—the primary source of all water-supply. The sources of rivers—which can most usually be traced to springs or the melting of mountain snows and glaciers, but also sometimes originate in a lake—are fed by the rains, which, running in tiny streams from higher levels, unite to form its tributaries. Part of this rainfall is evaporated and passes back into the atmosphere, another portion, running off the surface, forms rivulets, and ultimately rivers, and the remainder sinks into the ground; and the proportion which these three parts each bear to the whole rainfall depends upon the heat and dryness of the air, the slope of the ground, and its texture. In very hot countries, for instance, more of the rainfall will be evaporated, while in a hilly country more will run off the surface; and on soft and porous or *permeable* rocks, such as sand or chalk, more of it will soak in, while

a larger proportion of it will pass over *impermeable* rocks, such as clay and granite, which do not readily allow water to filter through them. The water-bearing strata are not, however, always horizontal, and unless this is the case water which has collected in a permeable bed will run off along the surface of an underlying impermeable one, and may issue at the surface—thus forming a *surface spring*.

The rainfall of a country[1] depends largely upon the direction of the prevailing winds, since when warm winds blow towards a cool district the decrease in temperature causes condensation, and much rain falls; and the rainfall will be greater also where the prevalent wind blows from the sea than where it blows from the interior. The presence of land masses, again, especially of mountains, tends to condense the vapour-laden air, especially on their windward slopes. Hence we find that on the western side of the Western Ghats in Southern India the rainfall reaches 260 inches, while the hills of Ireland, Scotland, and Norway, condense the moisture of the warm south-west wind, and thus account for the heavy rainfall of the western sides of those countries. And in addition to these causes, forests tend to increase the rainfail by checking evaporation, and wherever these have been extensively cleared it has

[1] Rainfall, that is the amount of rain that falls in a given time, generally a year, which naturally varies very much on different portions of the earth's surface, is calculated in inches, an inch of rain representing about 100 tons of water to the acre, or 64,000 tons to the square mile ; and thus London, for example, having a rainfall of about 24 inches, it follows that all the rain falling in the city in an average year, if none were lost by any of the three processes above described, would cover the surface with water to a depth of 24 inches.

been noticed that long periods of drought become common, and that the rain, coming at uncertain intervals, assumes a torrential character.

The area which a river drains, or over which the rainfall tends to flow into it or its tributaries, is termed its basin. The boundary line or water-parting of a river basin is the ridge along the summit of the valleys of the river and its tributaries, on each side of which the rainfall flows in opposite directions into two different river basins; and the slope down which the river flows is called the *watershed.* Owing to variations in the rainfall, portions of a river basin may be subject to very different meteorological influences affecting the flow of its tributaries, and "the flow of the main river consists of a combination of these various influences, which are successively imparted to it at the confluences of its various tributaries."[1]

So much it seems expedient to premise concerning the natural causes from which rivers originate before proceeding to particularise the general features of the system as existing in the United Kingdom, which offers peculiar advantages for the development of conservancy.

The rainfall throughout the three kingdoms, though it decreases in each case from west to east, furnishes a steady and copious supply for the numerous streams, rivers, and lakes, which, while differing in character in the different countries, constitute an essential feature in the physical geography of all of them.

The average rainfall of England and Wales is

[1] Cf. *Rivers and Canals*, by Leveson F. Vernon Harcourt, M.A., M.I.C.E., 1896, vol i., pp. 1-7.

32 in. per annum, giving a total fall in the year of more than 27,019,632 millions of gallons, but that in the mountainous districts of the north-west is greatly in excess of this amount, and 22 in. per annum may be relied on in the dryest districts.[1] The more important agricultural districts of Scotland have a rainfall under 30 in., and that of a greater part of the country is under 40 in., while that in some places in the west amounts at times to 60 and even occasionally 80 in. per annum.[2] In Ireland, the shores of which throughout two-thirds of their circumference are washed by the Atlantic, the moisture of the air is greater than in England, and the rainfall, which varies from 30.87 in. in Dublin to 40 in. in Cork, and in some places amounts to 60 in., averages 40 in. per annum.[3] As compared with continental countries, Great Britain also possesses special advantage in the number of its tidal rivers, which have not only an immensely greater flow than those that are tideless, but are also much more valuable for the purposes of maritime trade,—the Humber, for example, though draining but one-thirtieth part of the area drained by the Danube, which is tideless and

[1] Cf. *Physical Geology and Geography of Great Britain*, by Sir A. C. Ramsey, F.R.S., pp. 492-94; an essay by Mr F. Toplis read at the Congress of the Society of Arts on National Water-supply, Sewage, and Health, *Report*, p. 7; and *The Storage of Water*, by J. Bailey Denton, M.I.C.E.

[2] Professor Geikie in *Chambers's Encyclopædia*, Ed. 1903, Art. "Scotland"; and Mr H. A. Webster in Art. "Physical Features" in Groome's *Ordnance Survey of Scotland*.

[3] Cf. *The Industrial Resources of Ireland*, by Sir Robert Kane, M.D., pp. 70-2; and *Physical Geology and Geography of Ireland*, by Edward Hull, M.A., LL.D., 2nd Ed., p. 199. Sir Robert Kane estimated the total water power of the country as 3,533,565 h.p. over an area of 32,513 sq. miles.

flows into a tideless sea, having an ordinary volume at the mouth more than twice as great as the occasional flood volume, and eleven times greater than the mean flow of the latter river. Lastly, the tidal coast line of Great Britain, which is 3900 miles in extent, is greater than that of any other nation in Europe.[1]

According to a table given in the Report of the House of Lords Committee on Conservancy Boards,[2] there are no less than 210 rivers in England and Wales, draining an area of 54,971 square miles; but several of those included in this list are so insignificant in size as to be unnamed, and are designated merely as "streams."

The rivers flowing into the North Sea are separated from those that flow into the sea on the west by a great central water-parting, which, beginning at the Cheviot Hills, follows the Pennines along the Staffordshire Moorlands, bends round by the source of the Upper Avon, and from thence follows Edge Hill and the Cotswolds to Salisbury Plain. Another southern water-parting, which separates the rivers draining into the English Channel from those flowing into the Bristol Channel and the Thames, follows the Wealden Hills, the Hampshire Downs, Salisbury Plain, the Blackdown Hills, Exmoor, Dartmoor, and the Cornish Heights; and the rivers of England and Wales are divided by these two water-partings into three main systems.

The first of these systems comprises the rivers flowing into the North Sea, which on the whole are

[1] See paper by Mr. Edward Easton, C.E., President of the Mechanical Section read at the meeting of the British Association at Dublin in 1878; *Proceedings*, pp. 679-80.

[2] *Cf.* Appendix I., *post*, pp. 1-4.

longer, slower, and hence more navigable and less subject to sudden floods, and which cut their way through the central and eastern ridges of hills which cross the country from the south-west to the north-east. Of these, the Tyne, Wear, and Tees rise in the Pennines. The Humber, which brings more water to the sea than any other inlet on the east, receives the waters of the Trent, and of the Ouse (120 miles) which drains nearly the whole of Yorkshire, with its tributaries the Swale, Ure, Wharfe, Aire, Calder, and Don from the Pennines, and the Derwent from the North York Moors. The Trent (150 miles), rising in the Pennines, drains most of the central plain, while the Wash receives the waters of four sluggish streams, the Witham, Welland, Nen, and Great Ouse (150 miles). The remaining part of the eastern side of the country is drained by the Thames (215 miles), which rises in the Cotswold Hills, and flows with an easterly course to the sea, and by several smaller streams, such as the Kentish Stour, Chelmer, Essex Stour, and Yare.[1]

The second system may be said to include all the rivers draining the western side of the country. Of these, the Irish sea receives the waters of the Eden, Lune, Ribble, Mersey, Weaver, and Dee, none of which, however, from a navigable point of view, are of first importance except the Mersey. Other rivers drain into the Bristol Channel, by far the most important being the Severn which, rising

[1] Of the above rivers the Tyne drains 1100 and the Tees 774 sq. miles; the Trent and Ouse together about 9550 sq. miles; the Wash rivers—Witham, Welland, Nen, and Great Ouse—5850 sq. miles; and the Thames 6160, or including its estuary 10,000 sq. miles; *Physical Geology and Geography of Great Britain*, p. 495.

in Plynlimmon, flows through Wales in a north-easterly direction, and near Shrewsbury makes a bend to the south, entering the Bristol Channel, after a course of 200 miles, by a wide estuary, and receiving in its course the waters of the Warwickshire and Somersetshire Avons and the Wye.[1]

The rivers which drain into the English Channel constitute the third system, and of these the most important are the Tamar, which forms the estuary of Plymouth Sound, the Dart, the Exe, the Stour, and Hampshire Avon rising on Salisbury Plain, the Test and Itchin flowing into Southampton Water, and the Arun, Ouse, and Rother rising in the Weald.[2]

Except in the south, where the chief water-parting is in the centre, the main watersheds of Scotland are on the west coast, where the heaviest rainfall occurs, and the chief rivers, therefore, run eastward into the German Ocean. North of the Grampians we find the Spey, 96 miles long and draining 1245 square miles; while on the south slope of the range is the Tay, 110 miles long and draining 2090 square miles, and discharging a greater volume of water than any other river in the British Isles. The drainage of the southern uplands radiates from the centre, and three of the chief rivers—the Clyde, Tweed, and

[1] The Severn drains 8580 sq. miles, the Mersey 1748 sq. miles, the Dee 862 sq. miles, the Ribble 720 sq. miles, and the Eden 995 sq. miles; while if we take all the rivers running into the Solway Firth, including the Eden, the area drained amounts to 3000 sq. miles. *Ibid.*, p. 495.

[2] For fuller information with respect to the physical history of British rivers, see chaps. iii. and iv. of *Britain and the British Seas*, by H. J. Mackinder, M.A., Reader of Geography in the University of Oxford, pp. 110-26.

Annan—rising within a mile of each other, flow into the Firth of Clyde and the Atlantic, the German Ocean and Solway Firth respectively. The Clyde drains 1145 square miles, receiving at its mouth the waters of the Leven from Loch Lomond, one of the largest lakes in Great Britain. The Tweed, 96 miles long and draining 1990 square miles, forms part of the southern boundary of Scotland, and enters the German Ocean at Berwick.[1] The German Ocean also receives the waters of the Forth which is 116½ miles long and drains an area of 645 miles. This important river, which is tidal for some 55 miles—4½ miles above Stirling—is formed by the confluence at Aberfoyle, 80 feet above sea level, of two head streams rising on Ben Lomond, and flows through Stirling to Alloa, where it expands into the Firth of Forth, which is 51 miles in length, and varies in width from half a mile at Kincardine to 17 miles at Prestonpans.

The main watershed of Ireland extends from Fair Head co. Antrim to Mizen Head co. Cork. West of this line are the basins of the Bann, Foyle, Erne, Moy, Corrib, and Shannon; and to the east of it lie those of the Bandon, Lee, Blackwater, Slaney, Liffey, Boyne, and Lagan. The Shannon, with a total length of some 240 miles, drains an area of 4544 square miles, and receives several tributaries, the most important of which is the Suck which drains a large part of Connaught. The river Barrow (114 miles) rising in the Bog of Allen, with its tributaries the Nore and Suir (100 miles), which rise in the

[1] As to Scotch rivers, *cf.* also *Britain and the British Seas*, pp. 126-33, and *Physical Geology and Geography of Great Britain*, p. 495.

Sleive Bloom mountains, all uniting at Waterford, drain together 3400 square miles.[1]

Such are the main features of our water system; and it may be noted, in view of the consideration of the navigability of our rivers in earlier times, that it has necessarily experienced great changes in the course of ages. At the time of the Romans, for instance, springs were more plentiful and nearer the surface, while the rivers were more rapid and larger in volume, and, running in shallower beds, were fordable in many more places than at present.[2] The gradual destruction of forests, from the Roman times to the present day, has tended to the drying up of the country, and springs and river beds are believed to be lower now than they have ever been in historic times, and in addition to this, our rivers have produced as well as undergone great changes. Their erosive action, by wearing away the surface, forms valleys, while the sediment they carry away to other places, forms shallows, sand-banks, and bars.[3] The erosion is greatest on the upper course of a river where the slope is steepest, and in the middle part of its course it deposits at about the same rate as, and in the lower part more than it erodes. These deposits, at their mouths, and in the lower part of

[1] *Cf.* also as to Irish rivers, *Britain and the British Seas*, pp. 134-36; *The Physical Geology and Geography of Ireland*, 2nd Ed., pp. 199-235; and Kane's *Industrial Resources of Ireland*, pp. 71, 72.

[2] The Thames, for instance, is believed to have been forded, near London Bridge, by the Romans under Aulus Plautius.

[3] The mouth of the Thames was a wider estuary than at present, and probably more resembled the Wash in configuration, while large fens and salt marshes extended along the shores of Kent and Essex, where the tidal waters are in our times kept back by embankments; *Cf.* Pearson's *Historical Maps of England during the First Thirteen Centuries.*

their courses, are constantly filling up river beds and inundating the land; but the rapid tidal currents in the British Isles for the most part sweep such deposits away, although on each side of the Thames and some other rivers extensive banks of mud have been formed in this manner. Owing, presumably, to changes which have occurred in the position of the mountain ranges, through which they passed after they first began their course seawards, several Irish rivers, such as the Shannon, Blackwater, and Owenmore, and some English ones, like the Bristol Avon, the Stour, and Medway, now pursue a downward course which appears by no means the easiest or most feasible.[1] Other English rivers again, for similar geological reasons, after rising close to the sea run directly away from it, in some cases, however, turning round, and after a considerable detour debouching into it again at no great distance—such as the Camel in Cornwall, and the Tamar, Exe, and Torridge in Devon; the Yar and the Bure on the Norfolk coast; the Yorkshire Derwent, and the two Yar rivers in the Isle of Wight.[2] Some of the Welsh rivers, like the West Cleddau, which, rising near Strumble Head in Cardigan Bay, runs straight inland and falls into Milford Haven, behave in a similar fashion;[3] and in Scotland no ranges of hills at all intervene between the basins of the three principal rivers in the lowlands —the Tay, Forth, and Clyde—and the country is nearly divided into two halves by the Firths of Forth

[1] *Physical Geology and Geography of Ireland*, 2nd Ed., pp. 199, 201, 204, 207, 213.

[2] Cf. *The Scenery of England and the Causes to which it is due*, by the Rt. Hon. Lord Avebury, F.R.S., p. 381.

[3] *Ibid.*

and Clyde which penetrate the plain between them on opposite sides.[1]

Our rivers have thus, as Lord Avebury remarks in his *Scenery of England*, "had many conflicts and vicissitudes; they are of venerable antiquity, have carved out mountains, filled up lakes, have changed the whole face of the country, and lowered the general surface many hundred feet since they first began to flow."[2] Some rivers, such as the Trent, and all the larger rivers of the east, as far as the Bedford Ouse, are of comparatively recent origin. Others date back to a very remote period, and different parts of what is now considered a single river are of very different ages; and Lord Avebury is of opinion that many of our river valleys are pre-glacial, and that the old pre-glacial channels are generally deeper than the existing river beds. The Thames is, he considers, probably an older, and was formerly a much larger river than the original Severn, which, beginning as a small brook, gradually ate its way back, and annexing the rivers of Western Wales, cut them off from the Thames, and deprived it of most of its head waters.[3] Similarly, the Ouse, which is gradually approaching the Cherwell, threatens to carry off the upper half of the Cherwell area, detach it from the Thames, and annex it to its own basin, and along the whole line of the Chilterns the Thames is gradually receding, while the tributaries of the

[1] *Cf.* Mackintosh's *History of Civilisation in Scotland*, vol. i., p. 36.

[2] *The Scenery of England*, pp. 358-59.

[3] The dry valleys on the Downs and the Cotswolds, and the magnitude of the valleys in comparison with the present volume of the streams flowing through them, are accounted for by this theory; *cf.* too, as to the Origin of River Valleys, Ramsey's *Physical Geology and Geography of Great Britain*, p. 496 *et seq.*

Great Ouse are gaining ground.[1] At Dorchester, where the Isis joins the Thames, the pre-Roman fortifications show that at least 2000 years ago the Thames ran in its present course and at its present level; but while the upper waters of the river are still slowly deepening their valleys, the central part of its course is almost stationary and the lower part is at present probably raising its bed.[2] The Swale, the Nidd, Aire, Calder, and Don, which probably were all originally independent streams working their way to the sea, have been captured by the Yorkshire Ouse and carried into the Humber, which, through the union of the Yorkshire Ouse and the Trent in its estuary, has the largest river basin in England—9530 square miles, or one-sixth of the entire kingdom in extent, that of the Thames being 5244, that of the Shannon 4544, and that of the Severn 4350 square miles respectively.

Summing up the principal uses which belong to our natural waterways, Mr Vernon Harcourt remarks that "Rivers form a natural and easy means of communication between the sea and the interior of a country, and afford safe and convenient roadsteads for vessels. They also furnish the chief sources of water-supply; and the most fertile districts are situated along their banks. Consequently, most of the important cities of the world have been built on the banks of rivers. Rivers, however, are not

[1] "The present source of the Thames is about 600 feet above sea-level; in 9 miles it has descended the first 300, and in 11 more another 100 to the 200′ contour line near Lechlade, after which it takes 72 miles to fall to 100 feet which is reached near Great Marlow, and 48 miles more to the 28′ level at London Bridge;" *Scenery of England*, p. 375.

[2] *Ibid.*, p. 376.

always suitable for navigation in their natural condition, even in the lower portions of their course; and, owing to the continual changes taking place in their channels and at their outlets, they are liable to deteriorate if left to themselves. Moreover, rivers, whilst serving as the main arteries for the drainage of a country, and proving most valuable in hot countries for irrigating lands during the dry season, and as a source of water power, are liable to devastate their valleys by extensive floods during periods of excessive rainfall. Accordingly, the regulation, improvement, and control of rivers constitutes one of the most important, and at the same time one of the most difficult branches of engineering."[1]

[1] Cf. *Rivers and Canals*, vol. i., pp. 1, 2.

CHAPTER III

THE EVOLUTION OF WATER CONSERVANCY

The water system of the United Kingdom has been developed without regard to theoretical conservancy. Each branch of conservancy established independently. Hindrances to effective development caused by industrial competition and proprietary rights. Conflict between legal and scientific aspects of conservancy. Private and public rights in water. Interference with rights of private property for the public benefit a modern innovation. Effect of the principle on water conservancy. Lord Hale's definition. Conservancy of fishery. Conservancy of navigation. Conservancy of water-supply. Prevention of pollution.

THE water system of the United Kingdom, which formed the subject of the last chapter, has, it need hardly be said, been developed without any regard to the theory that water conservancy consists in the scientific treatment of all water received from the clouds from its first arrival till it merges in the ocean; for this theory—the soundness of which it seems impossible to question—is the result, on the one hand of the progress of science, and on the other of the requirements of modern civilisation. In the thirteenth century, when conservancy first became the subject of legislation, our extensive water system in its natural state still so amply sufficed, with the aid of such rudimentary forms of

conservancy as then existed for the limited needs of the nation, that it would have been unnecessary for our ancestors, had they possessed the knowledge requisite for the purpose, to attempt to deal with that system as a whole. In water conservancy, as in other practical sciences, "necessity" has been the "mother of invention," and its various branches have been established at different periods when each acquired importance; and while the mode and extent of their development has been determined by our industrial progress, it has also been materially affected by the fact that a large porportion of our water system has, from time immemorial, been the property of, and subject to, various rights and easements enjoyed by private individuals.

The lawyer, who is concerned only with the proprietary rights and incidents attaching to it, naturally regards water from a standpoint diametrically opposite to that from which it is regarded by the engineer and scientist, who are interested only in its value for industrial and domestic purposes. To the latter, a watershed is a vast, natural reservoir for receiving the element he desires to utilise. To the former, who recognises no property in water *per se* apart from the land it covers,[1] a watershed represents a collection of estates in land—owned partly by the Crown as representative of the State, and partly by private individuals, the value of which is increased or diminished by the fact that it is covered with or contains a certain amount of water.

[1] An action to recover the possession of water must be brought in respect of the land which lies at the bottom, and the description must be "so much land covered with water"; *cf.* Blackstone's *Comment*, vol. ii., p. 18.

Though the public may by express grant, immemorial use, or Act of Parliament acquire the right of navigation in rivers, the soil of whose bed is the property of private individuals, this right is simply one of passage which does not affect the ownership of the soil; and the only portions of our water system, which can be classed as *public* property, are rivers which are both tidal and navigable, the ownership of whose bed is vested in the Crown for the benefit of the public, and in which the public possesses the common law rights of fishery and navigation. Nor, it may be added, is the exercise even of these rights altogether uncontrolled by those enjoyed by private individuals who are owners of river lands. That of fishery has been considerably limited in scope by the extent to which the Crown in early times exercised the prerogative it possessed prior to Magna Charta of depriving the public of it by granting the exclusive right of fishery in tidal waters to private individuals; while that of navigation, though paramount to the rights of property of the Crown and its grantees in the bed of a river, is confined to the use of the water as a highway, and the public have no common law right to moor at, or land on, or tow vessels from the banks which are private property, though such rights have been largely acquired by custom or prescription.

From the point of view of the scientific conservator, therefore, the greater part of our water system may be described as being *private* property. As the owner of an estate in lands also owns all that is above and below the soil,[1] he is entitled to all

[1] In accordance with the legal maxim: *Cujus est solum ejus est usque ad cœlum.*

the water found upon it in the form of springs, wells, pools, ponds, and natural or artificial watercourses[1] flowing in a defined channel either above or below ground. He has, however, no property in percolating water, having no defined course, and is therefore liable to be deprived of its use through land drainage, or the sinking of a well on a neighbouring estate; while his ownership in streams and rivers ceases at the point where they leave his estate, and is further qualified when they flow between his lands and those of other owners, the ownership of the river bed in such cases being equally divided between the two proprietors of the lands on its banks by the imaginary boundary of the central thread of the stream. Thus, while a portion or, more rarely, the whole course of a river from its source to the sea may, provided it be unnavigable, sometimes be the property of a single owner, rivers are usually the common property of several proprietors who—in addition to rights arising from their ownership of the soil, among which that of fishery, though now in practice frequently separated from it, is *prima facie* included—possess certain common rights to the use of the stream in virtue of its contact with their lands and their consequent right of access to it. These riparian rights, as they are termed, which must be so exercised by each proprietor as not to injure the similar rights of others, belong to riparian owners, on navigable as well as unnavigable rivers, though in the case of the former they are subordinate to the public right of navigation, and

[1] A watercourse has been legally defined as "water flowing in a channel between banks more or less defined," by Lord Tenterden in the case of Rex *v.* Oxfordshire, 1 *B. & A.* 301.

include the use of the stream in its natural quantity and quality for domestic purposes, irrigation, watering sheep and cattle and working mills, etc., and, on navigable rivers, the right of access to wharves and landing places. In addition to these natural rights of property and riparian ownership, water is also subject to various easements, or rights adverse to those of others, which may be acquired by grant or prescription; such as the rights to diminish the natural volume of a stream by diversion, or to impair its natural quality by pollution, and the rights to discharge water on a neighbour's lands, or to construct an artificial watercourse over them. And lastly, since the early part of the sixteenth century, the complexity of this system of co-existing public and private rights has been increased by the grant, under numerous private and local Acts, of the extensive powers by which conservancy authorities, canal and water companies, and local authorities supplying their districts with water, are enabled compulsorily to acquire lands and springs for the purpose of their works, to construct artificial water-courses and reservoirs, and to lay down pipes in private and urban property.

The sanction given by the State to the principle of interference with private property in order to carry out works for the public benefit, under which the last-named class of statutory water rights has been created, may be said to mark the *beginning* of the modern era of *water conservancy*, the original scope of which is shown by the definition given of it by Lord Hale in his great work "*De Jure Maris*," which, as it is, so far as the authors have been able to discover, the earliest on the subject, it is interesting

to compare with the modern one referred to in the two preceding chapters. The "Office of conservancy" is, he says, of two kinds. The first is that relating to "*nuisances in rivers*," founded on the Statute 1 Hen. IV. c. 12, an Act passed in 1399 to provide for the appointment of commissions to scour and keep the waters of great rivers, and to correct and amend the defaults; and the second is, "*the conservancy as to fishery*," mentioned in the Statute 1 Eliz. c. 17,[1] and founded on the Statute of Westminster 2, c. 47, passed in 1285 for the protection of salmon.[2] In the seventeenth century, when Lord Hale wrote, conservancy was therefore limited to the removal of obstructions to navigation, the protection of salmon fisheries, and the prevention of floods in navigable rivers; and it is noteworthy that both the two first-named branches of conservancy may be said to have originated in the abuse of the rights of fishery by private owners. The "nuisances in rivers," referred to in the Act of Henry IV., appear to have been principally the weirs, kiddles, fishgarths, and stake nets which are shown, by *Domesday Book* and succeeding ancient records, to have provided the usual methods in early times for utilising fisheries, and which had become such an impediment to navigation in all the great rivers two centuries before the passing of that Act, that it had already been enacted in 1225 by Magna Charta, the provisions of which in this respect were repeated in two subsequent Acts of Edward III., that all weirs should be "entirely put down on the Thames and Medway and throughout

[1] Passed in 1558.

[2] *De Jure Maris*, Harg. Tracts, p. 23.

all England, except by the sea coast."[1] Weirs and fishing engines were also destructive to migratory fish, and, though the Statute of Westminster 2, which is the first Act which fixed a close time for salmon, does not relate to them, and the "conservancy as to fishing" is not expressly mentioned in Magna Charta and the earlier Acts as to weirs, an Act passed in 1472 (12 Ed. IV. c. 7) describes these Acts as being passed for the protection of the fry of fish as well as that of navigation.[2]

Subsequent legislation with respect to fishery has throughout been based on the principle of these earlier Acts on the subject—the regulation, namely, of public and private fishery rights by means of the establishment of close seasons, the removal of obstacles to the passage of fish, and the prohibition of acts prejudicially affecting the quality and volume of the water containing them, as well as of methods of fishery calculated to interfere with their natural increase. The enforcement of this system, which has been gradually extended to meet the requirements of different periods, has successively passed from commissioners appointed by the Crown to conservators appointed by Justices of the Peace, and finally to the present conservancy boards appointed by the County Council which control fishery districts usually comprising a whole watershed; and the general supervision of fisheries throughout the kingdom, first entrusted to the Home Office in 1861, and subsequently transferred to the Board of Trade

[1] Cf. *The History and Law of Fisheries*, by Stuart Moore, pp. 23, 24, 171. The two Acts referred to are 25 Ed. III. c. 4 (1350), and 45 Ed. III. c. 2 (1371).

[2] *Ibid.*, pp. 173, 175.

in 1886, is now by an Act of 1903 vested in the Board of Agriculture.[1] The general tendency of the development of this branch of conservancy, which has from the first been more or less under the control of the State, has been therefore towards uniformity and the centralisation of authority, but in the case of those of navigation and water-supply, the development of both of which is mainly due to private enterprise, this tendency has of necessity been much less marked.

The conservancy of navigation was from the earliest times entrusted to the Crown, the king being, as Lord Hale tells us,[2] "conservator of all ports, havens, creeks, and arms of the sea, and protector of the navigation thereof," in virtue of his office of Lord High Admiral, and having "a jurisdiction to reform and punish nuisances in all rivers, whether fresh or salt, that are a common passage, not only for ships and greater vessels, but also for smaller—as barges and boats." This prerogative, which is exemplified by the provisions already mentioned in Magna Charta and the early statutes with respect to the removal of weirs, was, however, delegated to various subordinate authorities, the most important of which were commissions of "sewers" —a term of uncertain derivation which seems probably to have been a diminutive of *river*[3]—the

[1] 3 Ed. VII. c. 31.

[2] *De Jure Maris*, Harg. Tracts, p. 23.

[3] This is the meaning of the term in the opinion of Mr Serjeant Callis (*cf.* Callis on *Sewers*, p. 80). It has also, however, been derived from *seioir* to sit, and *eau* water (Termes de la Ley), and by others from *sea* and *were;* while others again maintain that it merely means to *sue* or *issue*, whence *suera; cf.* Woolrych's *Law of Sewers*, 3rd Ed., p. 1. See App. IV., *post*, pp. 313-315.

appointment of which was first authorised in 1427 by 6 Hen. VI. c. 5, and whose functions formed the subject of many subsequent Acts, of which the most important is the Statute of Sewers passed in 1531,[1] which provided that such commissions were to be issued from time to time as need required, and that their powers and duties were to be confined to the particular districts for which they were appointed. They were empowered to maintain useful works and remove nuisances, the principal subjects under their jurisdiction being walls and similar defences against inundation from the sea or navigable rivers; bridges, trenches, mills, and other things incident to river conservancy which were liable to prove obstructions; navigable rivers, watercourses, streams and pools; sewers and gutters. The inconveniences arising from the temporary nature of these commissions, the duration of which was originally only three years, led, however, to the enactment of an Act in 1861,[2] providing that when once issued they should continue until superseded by the Crown, and that their ordinances are indefeasable until set aside by subsequent courts of sewers; and the greater part of their functions have now also been transferred by legislation to various corporate bodies of modern growth, having all the powers of permanent commissions of sewers. Except in such parts of the sea coast and such navigable rivers as are not under the supervision of such authorities,[3] their powers as to defences against inundation are now almost universally exercised by the corporate bodies of conservators in whom the majority of the navig-

[1] 23 Hen. VIII. c. 5. [2] 24 and 25 Vict. c. 133.
[3] See App. IV., *post*, pp. 313-315.

able rivers, ports, harbours, and docks of the kingdom are vested. Their jurisdiction with respect to sewers (using the word in its ordinary sense), drains, and nuisances has been transferred to various local and sanitary authorities throughout the kingdom. That with respect to watercourses, streams, and pools was transferred in 1864 to the Inclosure Commissioners, who, in addition to their functions under other statutes, were entrusted with the execution of the Improvement of Land Act of that year,[1] providing for the advance of loans for land drainage works, irrigation, and the permanent embankment of land from the sea or inland waters, and all of whose powers have since 1889 been vested in the Board of Agriculture.[2] And lastly, that with respect to navigable rivers has passed, with the addition of the important statutory rights already alluded to, to the three different classes of conservancy authorities amongst whom the control of our natural and artificial waterways is divided—the conservators of rivers that have been navigable from time immemorial, the conservators of such as have been made navigable by Act of Parliament, and the various canal companies. All these authorities differ from commissioners of sewers in the fact that they are the proprietors, though solely for the purposes of navigation, of the bed and banks of their respective waterways; and while the conservators of a river made navigable have greater rights as against the public than the conservators of one on which all the public rights attaching to a navigable river have always existed, the obligation

[1] 27 and 28 Vict. c. 114.
[2] 52 and 53 Vict. c. 30.

common to both to devote all their profits solely to the maintenance of their waterways distinguishes them from canal companies which maintain their navigations for their own benefit.[1] Though all these varieties of inland navigation are nominally under the supervision of the Board of Trade, the conservancy of navigation is thus practically entrusted to a number of independent competing authorities, the large majority of whom, owing to the conditions under which canals were originally constructed, control only portions of rivers, or of through canal routes.

The conservancy of water-supply, which has from the outset been conducted by private enterprise and has therefore been developed on much the same lines as navigation, is similarly divided between three classes of practically independent authorities—water companies having the parliamentary powers already referred to; companies which, having no such powers, lay their pipes in public ways at their peril, and can only acquire lands, and water, and levy tolls by agreement; and local authorities. Of these, local authorities—which, though they remained few in number till within the last fifty years, were first authorised to undertake water-supply in the sixteenth century—resemble river conservators in the fact that they perform this duty solely for the benefit of the public, while both classes of water companies, like canal companies, are entitled to all the profits accruing from their undertakings. Local authorities are under the general control of the Local Government Board, and both classes of companies under

[1] See *The Law relating to Waters*, by H. J. W. Coulson and U. A. Forbes, 2nd ed., pp. 460-67.

that of the Board of Trade. The enterprises of all these bodies are, however,—like those of all the authorities entrusted with the conservancy of navigation,—designed solely to meet local needs and without regard to national requirements on the subject; though an element of uniformity, wanting in the case of navigation authorities, has been introduced into the conditions under which they work by the obligation imposed on companies having parliamentary powers and on local authorities, of inserting in their private Acts certain general provisions with respect to the acquisition of land and water.[1]

It will have been observed that, owing presumably to the fact that in the then existing conditions of civilisation no system had been found necessary for the purpose, water-supply is not included in Lord Hale's definition of the "office of conservancy," and within the last half century another branch of the subject, which would have seemed equally unnecessary in his day, has come into existence, namely, the prevention of pollution, which differs from those already noticed, which may be termed *regulative* and *constructive*, in being purely *remedial*, and is still only in the first stages of development. The common-law rights of riparian owners on the subject have been already noticed, and these have, since 1876, been supplemented by the enactment of stringent prohibitions of pollution, the enforcement of which is, however, delegated to such private individuals as may be disposed to undertake legal proceedings for the purpose, and by the grant to certain county councils of powers

[1] *The Law relating to Waters*, pp. 309 *et seq.*

under local Acts to put these general prohibitions into operation in a few rivers.[1]

It will be evident from this general survey of the subject that the State has until recent times played but a small part in the development of water conservancy, and that each of its branches has thus had a distinct history of its own. It is now proposed to consider that of navigation.

[1] *The Law relating to Waters*, p. 177 *et seq.*

CHAPTER IV

NATURAL WATERWAYS

Three distinct periods in history of conservancy of navigation. Era of natural waterways. Primitive vessels. Application of river conservancy during the Roman occupation. And subsequently. British river gods. Use of rivers as highways by Danes and Anglo-Saxons. Provisions with respect to navigable rivers in the Laws of Edward the Confessor. Enumeration of principal English rivers by Sir John Fortescue (*temp.*). Henry VI. Survival and disuse of old English ports. The port of Lewes. Cambridge an emporium of medieval trade. Cost of water carriage in the Middle Ages. Evidence as to the navigability of the principal English rivers. The Thames, Severn, Bristol Avon, Yorkshire Ouse, Humber, Lea, Tyne, Exe. Importance attached by the State to the conservancy of great rivers.

We have endeavoured in the preceding chapters to form some idea of the objects of water conservancy, and the general conditions, physical and legal, under which it has been developed. It is now proposed to trace from early times the gradual appropriation of our rivers for their predominant use—that of navigation, the history of which comprises three distinct periods. During the first of these, which dates from British times and may be termed the era of natural waterways, navigation was carried on without any attempt to regulate the natural flow or course of rivers. A new era began with the initiation, towards the close of the sixteenth

century, of practical river conservancy, the earliest operations of which—though schemes, which do not appear to have been attempted, were also projected during this period for uniting the principal rivers by cuts—were limited to improving the channels of navigable rivers, and making others not previously so available for navigation. The construction by James Brindley in 1759 of the Bridgwater canal marks the beginning of the third and most important phase in the development of our system of inland navigation, which, judging by the success of its latest and most notable result—the Manchester ship canal—may be regarded as still continuing. Each of these periods demands a separate notice, and in the present chapter we shall consider the principal features of that which has been described as the era of natural waterways.

The first conception of the use of rivers for the purpose of navigation must have been the primitive one of utilising the trees cut down, or accidentally overthrown in the forests, and floating them down stream. To this would succeed the process of fastening together several trunks of trees, more or less trimmed and fashioned, and capable of carrying down a navigating crew, together with such products and commodities from the upper country as would be reasonable objects of sale or barter. In primitive and hilly countries, to this day, logs are floated down the rivers and mountain torrents, with the result of many a "log-jam"—such as described so vividly by Rudyard Kipling as occurring in a state "on the road to Thibet, very many miles in the Himalayas;"[1] and the lumber-rafts, which

[1] *Life's Handicap*, London, Macmillan, 1892, p. 240.

are now such familiar objects on the gigantic streams of British North America, may be looked upon as, to some extent, survivals of this method of water transit. There can be little doubt but that the Romans, during their occupation of the country, were fully alive to the natural advantages that its river-system afforded for navigation, and that they even anticipated the more modern engineering feat of straightening rivers by means of cuts. The Caer-dyke or Carsdike[1] was projected by Agricola, and perfected by Severus, to carry corn in boats for the army in the north. It was conducted from Peterborough into the Trent at Torksey, below Burton, whence the navigation was carried on by natural rivers to York. Carausius repaired it, and continued it on the borders of the fenny level as far as Cambridge, which he built and called Granta. This place was the head of the navigation, and Carausius instituted the great fair when the fleet of boats set out with corn and other provisions, which was, so late as the middle of the eighteenth century, still kept with many of the ancient Roman customs under the name of Stourbridge fair.

A large majority of the British towns were

[1] Some derive the name of this work from that of Carausius, who was appointed in the reign of the Emperors Diocletian and Maximinian (A.D. 288) to the command of a strong fleet, the head-quarters of which was in the British Channel. It is uncertain whether he was a Belgian or a Briton by birth. He was employed with great success against the pirates of the Baltic, and was accused of collusion with them. His cause was espoused by the legions and auxiliaries then in Britain, and the Emperors, finding their attempts to reduce him repelled with disgrace to their own arms, conceded to him the government of Britain, Boulogne, and the adjoining coast of Gaul, and the title of Emperor.

situated near the sea or on rivers, generally at points where at least one of the main roads crossed a river, and frequently at the point where it ceased to be navigable, showing that water carriage was a prevailing method of transit. Thus we have Colchester on the Stour, Rochester on the Medway, Peterborough on the Nen, York on the Ouse, Chester on the Dee, Lydney, Gloucester, and Wroxeter on the Severn, Caerleon on the Usk, Southampton and Portsmouth on arms of the sea.[1] Before the Roman occupation, internal communication was carried on by means of rivers and ridgeways running from the high ground to the shipping ports, the chief means of water transit being the "coracle"—a small round boat with a keel of thin planking, and sides of basket work covered with hides. Pliny alludes to the British coracle as constructed of basket work, over which leather or prepared hides were stretched;[2] and boats very similar in construction, and differing only slightly in shape,

[1] *Cf.* An article by Mr Alfred Taylor, F.R.G.S., in *Archæologia*, vol. xlviii., p. 229, "New Points in the History of Roman Britain, etc." It may be added that the name of the river Usk is evidently a corruption of the Celtic word Uisg = water; hence "usquebaugh" = water of life. The town of Uxbridge, on the Colne, probably takes part of its name from the same source, as do wholly the rivers Exe, Esk, and possibly others.

[2] "Though the leather boats of the Britons chiefly attracted the attention of foreigners, as being most unusual with them, we must not suppose they had no others. They certainly learned to build vessels of wood while under the Roman dominion if they had them not before. About this time, even in the remote western islands, they had long vessels built of oak planks; and they all carried at least one sail. Some of the vessels covered with leather were sufficient to go long voyages; at least as far as from Ireland to Orkney, and even to advance as far as the Northern ocean, as a run of fourteen days with full sail before a fair wind."—Macpherson's *Annals of Commerce*, vol. i., p. 224.

are to this day in use on the rivers of Wales, and on the west coast of Ireland where they are called "currachs." Another kind of British boat seems to have been made out of a single tree, like an Indian "dug-out." Several of these have been discovered in various parts of the country. In 1736 one was dug up from a morass called Lochar Moss in Dumfriesshire. It was 7 feet long, widening considerably at one end.[1] Another, hollowed out of a solid tree was seen by Mr Pennant, measuring 8 feet 3 inches long and 11 inches deep. In 1720 several canoes similar to these were dug up in the marshes of the river Medway, above Maidstone, one of them so well preserved that it was used as a boat for some time afterwards. On draining Marton-le-moor, near Ripon, there were found sunk at the bottom eight canoes, each made out of a single tree; and in 1834 a boat of the same description was found in a creek near the village of North Stoke on the river Arun, measuring 35 feet in length, 1 foot 10 inches in depth, and in the middle 4 feet 6 inches wide.[2]

In addition to these two classes of boats, it may be assumed that the lower portions at least of British rivers were frequented by the vessels used by the Britons in their extensive maritime trade, which Cæsar describes as being flat-bottomed and adaptable for navigating shallows and tidal waters as well as the open sea, and also by those of foreign merchants. Lud, the tutelary deity of the Britons,

[1] In Scotland these canoes have been also found in Wigtownshire, Renfrewshire, Argyleshire, and other counties, but chiefly in the valley of the Clyde. *The History of Civilisation in Scotland*, by John Mackintosh, vol. i., p. 70, and *cf.* p. 79.

[2] See Knight's *Pictorial History of England*, vol. i., pp. 102-3.

was also the god of commerce, and the importance they attached to their rivers for commercial purposes is shown by the fact that temples dedicated to him were erected both on the western bank of the Severn at Lydney, the name of which is derived from his worship there, and on Ludgate Hill in London—the Welsh Caer-Ludd—overlooking the Thames. "In British legend," says Colonel Cooper King, "Lud was his people's protector, and the cause of their prosperity. . . . He has a fleet, occasionally appears as a god of war, King of the Orkneys, with a temple at the mouth of the Severn and of the Thames. His reputation undoubtedly grew with the increase of British commerce, and the Roman merchant came and worshipped at his altars."[1]

The worship of Lud by Roman merchants, coupled with the construction by Agricola of the cut connecting the Trent and Nen with the Ouse mentioned above, appears to justify the presumption —though the authors have been unable to find any direct evidence on the subject—that the Romans made considerable use of the British natural waterways to supplement their great system of roads. In Anglo-Saxon times a grim proof of the navigability of such rivers as the Ouse, the Witham, and the Stour is to be found in the burning by the Danes of Ely, Lincoln, and Canterbury.[2] In addition to

[1] Cf. *Social England*, vol. i., pp. 88, 89.

[2] The Danes sailed up the Lea to Hertford in 894; see *A Chronology of Inland Navigation in Great Britain*, by H. Rodolph de Salis, p. 1. According to the English Chronicle of 897, Alfred, in that year, ordered "long ships" to be built to oppose the Danes. These were nearly double the length of the Danish boats, and unlike either these or the ships of the Frisians, and they had in some cases sixty, and in others even a greater number of oars; but in the first engagement

this more unpleasant aspect of their character to which Saxon chroniclers—and frequently, indeed, ordinary manuals of history—not unnaturally give especial prominence, the Danes and Northmen were, after they had established themselves in these islands, the leading merchants of Anglo-Saxon England. Under their influence villages sprung up at centres suitable for commerce which developed into towns, and others already well situated for this purpose received a new development, and all of these not on the coast were situated on navigable rivers. Thus Lincoln on the Witham, Cambridge and Stamford on the Ouse, were Danish burghs, and the presence of Danes in York and Exeter is evidenced by the churches dedicated to St Olaf and St Magnus, and in London by that of St Clement Danes. It was through the Danes, too, that Chester on the Dee, and Bristol on the Avon were brought into connection with Dublin, and Danish artisans and traders were settled in Dublin, Waterford, Wexford, Cork, and Limerick, all of which owed their selection in this respect to their being situated on rivers.[1] The importance of navigable rivers generally as highways during that period is shown by the fact that they were made—in conjunction with the four great roads of Watling Street, Fosse Way, Ermine Street, and Icknield Street—the subject of special provisions with respect to the preservation of the King's Peace

in which they were used off the Isle of Wight the West Saxons failed to manage them properly.—*Cf.* Cunningham's *Growth of Industry and Commerce*, pp. 82-3.

[1] *Cf.* Cunningham's *Growth of English Industry and Commerce during the Middle Ages*, p. 93 and note. The Danes were also instrumental in opening up commerce, hitherto confined to southern countries, to the trading settlements of the Northmen.

in the Laws of Edward the Confessor; and after the Norman Conquest the evidence as to both these points becomes much more abundant and explicit.

Sir John Fortescue, Chief Justice of England, and Lord Chancellor to Henry VI., in his *Commodities of England*, written probably before 1451, says: "Fyrst England has three Ryveverse within hymselffe comynge out of the see in to the myddes of the londe, whereby the shyppes of all maner charge, of all maner natyons, may convey and seylle to in the greateste cytes of the lond, both ebbe and flodde with all maner marchandyes.

"1. The fyrst Ryver ys called Humber, that comythe to Yorke and so forth up into the countrey. 2. The second Ryver is called Temys, whych comythe uppe to London and so forth into the countrey. 3. The thyrde Ryver is called Saverne, whych comythe to Bristowe, and so forth into the countrey." He goes on to add that England is "endowed and honoured" with many good harbours, "roodys" (presumably roadsteads), "and coverts from Newcastle upe unto the ryver of Saverne," and enumerates forty-eight ports in England and Wales, most of which are on the mouth or the course of a river. On the east coast were Tynemouth, Hartlepool, Whitby, Scarborough, "Flaymborough," "Humber" (Hull), Lynn, Deeping on the Welland in Lincolnshire, Ely, Yarmouth, "Kynkeley" near Lowestoft, "Downewych (Dunwich) havyn," "Orford havyn," "Orwell havyn," "Thanet ower Temys mouth," Sandwich, and "Downys." On the south coast were Dover, Lewes, Camber (between Winchelsea and Rye), Appledore on the Rother,

Pevensey, "Borne" (Eastbourne), "Seforde" West Deene on the Cuckmere, Havant, Portsmouth, Gosport, Porchester, two places on the Hamble which joins Southampton Water—"Hammelle Ryce" and "Hammelle the Hoole"—"all the holle Ryver up to Hampton" (Southampton), "Limyngton," "Polle (Poole) havyn," "the Weymouthe," "the Exmouthe," "the Dertemouthe," "the Plymouthe," "the Ffowe" (Fowey), "the Falmouthe, "the Bigge Watter," and "the hole ryver of Saverne." "And there be many other goode havyns," he adds, "that I have not named, and there be many other goode havyns in the cost of Wales, as Tynby, the wych is the 45th havyn of England, the 46th Mylford, the 47th Cayrdife, the 48th Bristowe."[1]

It is interesting to note how many of these old ports are still in existence, and the local records of others that have now ceased to be so doubtless contain proofs of their former use in this respect, similar to those mentioned by Mr Horsfield in his *History of Lewes.* "There still remains," he says, "evidence at Lewes of its having been a port in the name of Eastport Lane that runs along the bottom, skirting the stream, or bourn, which nearly severs the precincts of the town of Lewes from the burg [*sic*] of Southover, where, during the former part of the last century, an anchor was dug up, and where was, most probably, the nearest access to the town for *shipping.*" The ancient port of Lewes is supposed

[1] *Works of Sir John Fortescue, now first collected by Thomas Fortescue, Lord Clermont*, pp. 549, 550. Cf. *A Return from Harbour Authorities to the House of Commons* of June 1883, which gives a description of Works executed within the preceding twenty years, and enumerates some 650 harbours in the United Kingdom.

to have reached some distance higher than the town up to Landport, where another anchor has been discovered.[1] Deeping on the Welland, West Dean on the Cuckmere, and Ely are similar instances of disused up-river ports, and a still more important one, not mentioned by Sir John Fortescue, was Cambridge, which is described by Dr Cunningham in his *Growth of Industry and Commerce during the Early and Middle Ages*[2] as a "natural emporium for trade," not only on account of its situation on the Icknield road, but also because it was greatly favoured by the character of its *river*, along which goods could be easily brought from the port of Lynn. "It was here," he says, "that Oxford colleges laid in their stock of salted eels for use during Lent, and that wool and woollen cloth were largely bought;" and it was the seat of four of the annual fairs, at which much of the trade of the Middle Ages was carried on, while the greatest of these institutions, that of Stourbridge, was close to it. Nor was Cambridge peculiar in this respect. The scarcity and defective character of the roads during this period made water communication a necessity, and tidal streams enabled the small sea-going vessels of the day to penetrate far inland to the sites of the

[1] *Cf.* Horsfield's *Lewes*, p. 59, note. The Ouse was made navigable from Lewes to Hammer Bridge in the parish of Cuckfield with a branch to Shortbridge in the parish of Fletching, under 30 Geo. III. c. 52 passed in 1790, and subsequently amended by 31 Geo. III. c. 76, 40 Geo. III. c. 54, 46 Geo. III. c. 122, and 54 Geo. III. c. 176 (1814), but since the middle of the nineteenth century the navigation has fallen into decay. *Cf.* Rees, *Encyclopædia*, Art. "Canal," and Priestley's *History of Inland Navigation*, pp. 442, 523.

[2] Vol. i., p. 181.

chief towns, such as Chester, York, Ipswich, Norwich, and Doncaster.[1]

Professor Thorold Rogers, in his *History of Agriculture and Prices in England*, after examining the question of the cost of land carriage, says,[2] "We may therefore, I think, infer that while there were greater facilities for land carriage than has been ordinarily supposed, and that therefore the transmission of corn and other commodities to market was easy and obvious, there was still larger facility for those who, living on or near the banks of navigable rivers, might seek a better market than their immediate neighbourhood." The Thames, the Severn, the Wye, the Bristol Avon, the Cambridgeshire Ouse, the Humber, the Itchin, the Test, the Stour, and many other rivers were, he tells us, both navigable and commonly navigated; and he gives examples of the cost of water transport on the first three rivers. The carriage of 25 quarters of wheat from Middleton in Kent to London in 1284 cost 1s. the quarter; that of 50 quarters of wheat by water from Weston in Hertfordshire to London 2s. a quarter in 1292; and that of 50 quarters of oats from West Shene (Richmond) to London in 1316, 1s. 2d. the quarter. The cost of conveying 3 tons of herrings from London to Henley in 1353 was 11½d. per ton;[3] and a fother and 3

[1] *Growth of Industry*, etc., vol. i., p. 97. The navigability of the Hull a tributary of the Humber, in the thirteenth century, is shown by an Agreement made between the Archbishop of York and Lady Sutton in 1296 for the removal of certain weirs in it in order that vessels might approach the town of Beverley. De Salis's *Chronology of Inland Navigation in Great Britain*, p. 2.

[2] Vol. i., p. 663.

[3] In the Middle Ages the Thames, according to Professor Thorold Rogers, was permanently navigable to London only from Henley, the

quarters of lead was carried from Worcester to St Briavels in 1374 for 12s. 6d., the material being first carried down the Severn to Bristol, then sent back by the Ouse (Avon) and up the Wye to Monmouth, and from the latter place to St Briavels by land.

With regard to three of the rivers enumerated by Professor Thorold Rogers, it may be noted that the recital of an Act of 1750 (24 Geo. II. c. 8) speaks of the Thames as having been navigable, *from time immemorial*, from the city of London to the village of Bercott in Oxfordshire, and from the city of Oxford northwards beyond Lechlade in Gloucestershire, thus showing that the river between Oxford and Bercott was not navigable originally, and states that this portion of it was made navigable by 21 James I. in 1624. The "Mark Stone," standing in the meadows near Staines, bears the inscription "God preserve the city of London. A.D. 1280," showing that the jurisdiction of the Corporation over the river extended to that point in the thirteenth century, and in 1393 the Statute 17 Rich. II. c. 9 vested the conservancy of the fishery of this part of the Thames, and also of the Medway, in them. The name of the river first appears on the Statute Roll in two Acts of 1423 (2 Hen. VI. cc. 9, 15), the first of which empowered justices to inquire into and remove certain nuisances in the form of weirs and fixed engines called "kydels" and

market of which, as of other towns in Oxfordshire, was affected by those of London, owing to the cheap and easy navigation of the river. Thus the bailiff of Cuxham, a place 12 miles distant, always sold his corn at Henley, because he was there able to obtain London prices minus the cost of carriage ; see pp. 18, 663, 664.

"trinks" "*dehors les boundes de la franchise de Loundres en les comtes de Surr' Kent and Essex;*" while the other prohibited the practice of fastening nets either to these or to posts, boats, and anchors, "athwart the river of Thames and other rivers of the realm," on the ground that it both obstructed the passage of vessels and destroyed the brood and fry of fish.

Again, the first mention of the Severn on the Statute Roll is in the Statute 9 Hen. VI. c. 5, which was passed in consequence of certain grievous complaints made in Parliament in 1430-31 of Welshmen and ill-disposed persons who used to "assemble in manner of war," and stop "trows, boats, and floats or drags" on their way with merchandise to Bristol, Gloucester, Worcester, and other places; thus showing the navigability of the river up to these places. It may be added that the only remedy provided by the Act against these maurauders, who appear to have been wont to "hew in pieces these craft, and beat the sailors with intent to force them to hire boats from the said Welshmen for great sums of money," was a declaration that if any man's free passage in the Severn were thus hindered, he should have his action according to common law. That it had little effect probably on the Welshmen is evident from the fact that the Foresters of Dean, described in the recitals of an Act passed ten years later as certain "misruled persons," appear to have been guilty of similar practices, for the suppression of which penalties were imposed by 19 Hen. VII. c. 18. This Act, passed in 1503-04, also abolished all river dues and passing tolls levied by local authorities by prescription or charter in return for supposed services rendered to shipping, unless the parties

levying them made good their claim before the Star Chamber before Ascension Day 1505. It contains the noteworthy recital that "time out of mind" merchants and others had used the Severn "without interruption, trouble, vexation, let or disturbance," but "without anything therefore paying or giving," until lately certain officials in Worcester, Gloucester, and other places would not suffer any boat, trow, or other vessel to pass without divers impositions set and levied upon merchants and owners of goods and merchandise; and it is remarkable as the first clear statutory mention of local dues levied in an English river.[1]

Lastly, the Bristol Avon, the tributary of the Severn, is referred to in an Act passed in 1542-43 (34 and 35 Hen. VIII. c. 9) prohibiting the discharge of ballast into the Severn, which recites that the boats in which grain was exported from the river "into parts beyond the sea where grains are very dear," after receiving their cargoes, "cast out their ballast of stones and other rubble" to the great peril of merchant ships of great burden navigating the river; so that if redress was not had therein it would be "to the utter destruction of the haven and port of Bristol," which was chiefly maintained by course of merchandise.[2] There is also evidence

[1] Cf. *The History of Private Bill Legislation*, by Frederick Clifford, vol. i., pp. 6, 467.

[2] *Ibid.*, p. 472. The conservancy of the Avon from Hanham Mills to King's Roads in the Severn—a jurisdiction which included the two small islands of Steep Holm and Flat Holm in the Bristol Channel—appears to have been vested by various charters and grants from the Crown in the Mayor, Burgesses, and Commonalty of Bristol from the earliest times. See *A Historical Account of the Navigable Rivers, Canals, and Railways throughout Britain*, by Joseph Priestley, p. 67 *et seq.*

of a similar kind with respect to other rivers of less note than those just mentioned. Thus the navigability from time immemorial of the Yorkshire Ouse and the Ure is shown by the report of a suit heard at the Assizes in the year 1280 with respect to a dispute between the citizens of York and the Earl of Cornwall, Lord of the manor of Knaresborough, as to the right to take toll on ships and merchandise passing along those rivers between the city of York and the town of Ponteburg (Boroughbridge). Amongst the evidence put forward in support of the Earl's claim was a minister's account for the year 32-33 Ed. I. (1303-04), showing the receipt of £9, 5s. for parts of the freightage of boats carrying merchandise, and divers other things, between the two places, and that an official termed the "battellarius" took the other third of the freightage for his labour; while a further £9, 2s. is recorded as received of the fines of "divers men carrying dung in their boats upon the waters of the Ouse and Ure to Ovedon, Newton, Walfor, and other towns on the river, having license of old custom."[1] The conservancy of the Ouse, together with that of rivers Aire, Wharfe, Derwent, Don, and Humber, was entrusted by charter to the Mayor and Aldermen of York in 1462, and in 1531 we find an Act passed for "pulling down and avoiding fish-garths, piles, stakes, hecks, and other engines set in the river and waters of Ouse and Humber."[2] Again, in a statute of 1424, which appointed a commission to "survey, redress, and amend" all its defaults—

[1] Stuart Moore's *History and Law of Fisheries*, pp. 15, 16.

[2] De Salis's *Chronology of Inland Navigation in Great Britain*, pp. 3, 5.

3 Hen. VI., the first river improvement Act—the river Lea is described as "one of the great rivers which extendeth from the town of Ware till the water of Thames in the counties of Hertford, Essex, and Middlesex"; and in 1430-31 a petition of the Commons set forth "the *natural obstructions to navigation* from great numbers of shelves or shoals which be made and come by force and course of the water of Lea so that ships and boats cannot pass by as they ought." An Act, 9 Hen. VI. c. 9, was therefore passed, reciting these and other facts, and authorising the Chancellor to appoint commissioners with power to remove all these shoals, depositing them on the river banks, "provided that any can be found who will undertake to do the same"; and in case money were borrowed for the authorised works to collect, personally or by deputy, from each laden ship or boat leaving or entering the river, a toll of 4d. towards repayment of the loans.[1] The Tyne was navigable for a distance of 14 miles from a place at the mouth of the river named Sparhawke up to Hedwyn Streams, as is shown by an Act of 1529 (21 Hen. VIII. c. 6), which thus defines the limits of the port of Newcastle, and states that ships had always been allowed to unload at Newcastle, and nowhere else within the port.[2] In the same reign we find the city of Canterbury obtaining an Act for deepening the Stour,[3] and lastly, the navigability of the Exe is evidenced by a public Act of 1539 (31 Hen. VIII. c. 4), which empowered the corporation of Exeter

[1] *History of Private Bill Legislation*, vol. i., p. 468.

[2] *Ibid.*, vol. i., p. 475.

[3] 6 Hen. VIII. c. 17.

to remove obstructions to the navigation, paying compensation to the owners of the soil where the obstructions were situated.[1]

It will be evident from this survey of the subject that navigation had acquired considerable importance for centuries before it occurred to our ancestors to attempt to further its interests by the mechanical regulation of rivers, the freedom of passage on which was, as has been shown in a former chapter, carefully protected by the State. Conservancy during this period, therefore, consisted solely in legal provisions for this purpose. From the earliest times, Parliament endeavoured to keep open the course of navigable rivers by Acts such as Magna Charta, which enacted that all weirs should "from thenceforth be entirely put down on Thames and Medway and throughout all England except by the sea coast"; the Act of 1399 (1 Hen. IV. c. 12), which provided for the appointment of commissioners to "survey and keep the waters of great rivers and amend the defaults"; and an Act of 1472 (2 Ed. IV. c. 7), which states that legislation as to weirs was for the benefit of the navigation of rivers. It was not till almost a century after the passing of the last named statute that the series of private Acts for improving the navigation of rivers, which will form the

[1] Previous to the reign of Henry III., the tide came up as far as Exeter, and barges and small craft ascended the river as far as the watergate of that city, and prior to the Act of 1539, as well as subsequently, much money was spent without effect on its improvement until the making of a ship canal (the first canal made in England) by John Trew in 1563. See *A Memoir of the Canal of Exeter from* 1563-1724, by Philip Chilwell de la Garte, with a continuation by James Green, M.I.C.E., in *Proceedings of the Institute of Civil Engineers*, vol. iv., p. 90 *et seq*. *Cf.* pp. 95-6, 122, *post.*

subject of the next chapter, began to be put into operation.

It may be useful, in conclusion, to summarise the results we have endeavoured to arrive at, namely, the proof, from historical and documentary evidence, of the navigability of our rivers from the earliest times to the close of the Middle Ages, and before any attempt had been made to regulate their flow, or to overcome by mechanical processes the natural obstacles that existed. The various authorities quoted show that on the east coast the following rivers were wholly, or in part, naturally navigable—the Tyne, the Yorkshire Ouse with its tributary the Ure, the Humber, the Great Ouse, the Witham, the Stour, the Thames, and the Lea; on the south coast, the Ouse, the Rother, the Cuckmere, the Hamble, the Itchin, the Test, the Stour, the Exe, and the Dart; on the west coast, the Severn, the Wye, and the Bristol Avon. It is remarkable that in the foregoing list mention should have to be made of rivers, such as the Cuckmere, the Test, and the Canterbury Stour, which, if they have not entirely passed out of the category of navigable rivers, have long since ceased to be considered as of any importance in that connection.

CHAPTER V

THE CONSERVANCY OF RIVERS IN ENGLAND AND WALES PRIOR TO THE CANAL ERA

Utilisation of rivers for navigation affected by variations in development of our natural resources and industries. Illustrations of the relative importance of the rivers south and north of the Wash until the seventeenth century. List of the principal ports as evidenced by ship writs in 1618. Vessels of the period. Commercial enterprise of southern ports under the Tudors and Stuarts. The Lea made navigable by Act of Parliament. The Thames made navigable from Bercott to Oxford. Towns on the river described. Watermen and Lightermen. The "water poet." Barges, wherries, and tilt boats. Fares and rates. The first dredger. William Sandys and the Warwickshire Avon. Francis Matthew, the pioneer of river conservancy. Andrew Yarranton and his work. Series of Acts for making rivers navigable. Act for improving the Calder the first relating to northern rivers. Transfer of industrial supremacy from the south to the north.

THE importance of the navigable rivers referred to in the preceding chapter has of necessity been largely affected by the development of our natural resources and manufactures, and has varied from time to time with the alternations in the prosperity of the districts traversed in their course.

Of the navigable rivers flowing into the North Sea, the Tyne, Wear, and Tees, now pass through an important coal and iron district. The banks of the first named river, from Newcastle to the sea, are

the seat of coal, iron, shipbuilding, and chemical industries; the large coal-exporting and shipbuilding town of Sunderland stands at the mouth of the Wear; and Stockton and Middlesborough are on the estuary of the Tees, and Hartlepool a little to the north of it. The Witham, Welland, Nen, and Great Ouse drain an agricultural district, as does also the Thames. Of rivers flowing into the Irish Sea, the Mersey drains the southern portion of the great Lancashire coal-field, and most of the great cotton manufacturing towns lie in its basin. Of those flowing into the Bristol Channel, the middle portion of the Severn passes through an important centre of iron, carpet, and porcelain factories; and on the Avon, one of its tributaries, stands Bristol now rapidly recovering its old position of first-rate importance as a port.

At the time of the Conquest, however, when tin and lead were our chief mineral resources, and raw wool and hides the principal staple of our trade, the mineral wealth of the northern counties, which had been devastated, and their population decimated by the Conqueror, was undeveloped, and centuries elapsed before their inhabitants began to take a leading part in the industrial life of the country.[1] Until the seventeenth century the counties drained by the rivers flowing into the Bristol Channel remained, for the most part, almost as purely agricultural as those traversed by the Thames; and owing to the fact that English trade during this period was almost entirely limited to continental ports, the rivers south of the Wash were, with the

[1] *Cf.* Cunningham's *Growth of English Industry and Commerce during the Middle Ages*, pp. 1, 2.

exception of the Tyne, of far greater importance for the purposes of navigation than those to the north of it. Boston and Lynn, the two chief ports on the Wash, are said to have had a larger amount of shipping than any others except London, and merchandise imported there was transported for a considerable distance into the interior by means of the Ouse, Witham, and other rivers.[1] The earliest, and for centuries the most important of our manufactures, was that of—to quote Sir John Fortescue[2] —"woollen cloth, ready made at all times to serve the merchants of any two kingdoms, Christian or heathen," which originated in the immigrations of Flemish weavers in 1160 and 1328; and while there were in the reign of Henry II. guilds of weavers under royal protection at Oxford and London on the Thames, at Winchester on the Itchen, at Huntingdon on the Ouse, and at Nottingham on the Trent, the only city on a northern river where such a guild was established was York, which had been destroyed by the Conqueror, and only began to recover its importance in the twelfth century.[3] Tin mining, again, was of course confined to Devon and Cornwall, and a curious evidence of its effect on the rivers of those counties is furnished by a petition presented to Parliament in 1532, with respect to the silting up of the harbours of Plymouth, Dartmouth, Fowey, and Falmouth through the operations of "certain tynne workes called streame workes" conducted by certain

[1] Cf. *The Ancient and Present State of the Navigation of the Ports of King's Lynn and of Cambridge*, by Thomas Badeslade, pp. 2, 6-14; and *Tidal Rivers, their Hydraulics, Improvement, and Navigation*, by W. H. Wheeler, M.Inst.C.E., p. 29.

[2] *Commodities of England*, p. 551.

[3] *Growth of English Industry*, p. 469.

persons who "more regarded their own private lucre than the commonwealthe and suertie of this Realme"[1] —an abuse remedied by the enactment that the tinners were to have "sufficient hatchets and ties on the end of their buddels" to prevent the sand from being washed away by the streams.[2] Iron mining was also originally limited, and till the early part of the eighteenth century continued to be the chief industry of Sussex; and the fact that the earliest record with respect to it in medieval times is the grant, in 1266 by Henry III., of a toll of a penny to the town of Lewes on every cart laden with iron, seems to show that the Ouse may have been used for transporting the metal.[3] The first northern river to acquire importance must apparently have been the Tyne, on the banks of which a considerable trade, originated by a charter granted in 1259 by Henry III. to certain persons for the privilege of digging for coal at Newcastle, seems to have existed in 1281; but this trade also helped to augment the growth of southern ports. Dowell, in his *History of Taxation*,[4] states that there were sea coal dealers at Colchester, which place was reached by the river Colne, who in 1295 paid the tax on movables in respect of their stock of this commodity, and that at the commencement of the fourteenth century sea coal was used in London by smiths, brewers, and other traders, and that it was discharged by the

[1] 23 Hen. VIII. c. 8. [2] *Growth of English Industry*, p. 481.

[3] The first cannon made in England was cast by Ralph Hogge at Buxted near Uckfield in 1543, and Fuller writes that, "It is almost incredible how many great guns are made of iron in this country." A large proportion of British ships in the sixteenth century appear to have been armed with guns of Sussex manufacture.

[4] Pp. 397-98.

"coalers" or colliers at Sea Coal Lane where it was stored. Though its use was for a time checked by the pronouncement of physicians that it was unwholesome, and though Parliament petitioned Edward I. for its prohibition,[1] the trade in coal had so far recovered in the seventeenth century that in 1615 four hundred ships were employed in it at Newcastle, the mineral being conveyed to them in "keels" or barges pushed down stream to the deep water of the Tyne in which they lay; and about the time of Charles I. coal had come into general use in the metropolis and in most coast towns.[2] Shipbuilding, which steadily increased during the Middle Ages, and which was especially fostered by Henry V. in the fifteenth and by Henry VIII. in the sixteenth centuries, was carried on at most of the important ports; and the following list of those to which ship writs were issued in 1618 for procuring the vessels employed on the attack on Algiers—the only warlike operation at sea in the reign of James I.—shows that those on the southern coast considerably exceeded all the others both in number and importance[3]:—

London	£4000	Newcastle	£300
Bristol	2500	Southampton	300
Exeter	1000	Cinque Ports	200
Plymouth	1000	Ipswich	150
Dartmouth	1000	Colchester	150
Barnstaple	500	Poole	100
Hull	500	Chester	100
Weymouth	450	Lynn	100

[1] Dowell's *History of Taxation*, p. 398. [2] *Ibid.*, p. 398.

[3] *Ibid.*, p. 212. In the times of the Plantagenets, and before the foundation by Henry VIII. of a permanent navy, a work continued by Elizabeth, seaports were required to supply ships with men and equipment for the defence of the kingdom. *Ibid.* p. 213.

The names of the various types of vessel in use on our rivers at this time sound as strange as their structure would now appear if we came across them in any of the above-mentioned harbours. The fleet of Richard Cœur de Lion included, besides fifty armed galleys and a hundred transports or "vessels of burden," thirteen "busses" or "dromonds"—large vessels with three masts each carrying a single sail.[1] In the fifteenth century "vessels of burden" were built in imitation of those of the Genoese, and were termed "caracks," and the fleet of Henry V., who rewarded John Taverner of Hull for building a great "carack" by granting him exemption from the law of the staple,[2] comprised in 1417 eight "barges" and ten "balingers," besides six large vessels. During Henry's reign merchants like Taverner, showed great enterprise in shipbuilding,[3] and even in the expedition against Algiers in 1618, referred to above, twelve out of the eighteen ships were hired from private merchants.[4] The "balinger" or "balangha" was a sloop or barge, and the term was formerly

[1] Macpherson's *Annals of Commerce*, pp. 351-52.

[2] "Statute Staple" was a security in the nature of a bond for a debt acknowledged to be due before the Mayor of the Staple—the chief mart for the principal commodities of the kingdom formerly held by Act of Parliament in certain trading towns—under which not only the body of the debtor might be imprisoned and his goods seized in satisfaction of the debt, but also his lands might be delivered to the creditor until the debt had been satisfied out of the rents and profits. Brown's *New Law Dictionary*, Art. "Statute Staple," p. 341.

[3] *Growth of English Industry*, p. 411 note. During Henry V.'s reign William Canynges owned 2853 tons of shipping, among which was one vessel of 900 tons burden. *Ibid.*, p. 413.

[4] *History of Taxation*, p. 213. Prior to the invention of cannon there appears to have been little difference between merchant vessels and ships of war. *Cf.* as to barges and balingers, Rymer's *Fœdera Record Ed.*, vol. iv., pp. 39, 41.

made use of to describe small vessels of war without forecastles. The term "barge" was in early times (*e.g.*, the reign of Richard II.) applied to men of war of about 100 tons; and possibly there is a reminiscence of this application in the modern "barges" used by Admirals and Captains in H.M. Navy, which are of long, slight, and spacious construction, generally carvel-built and double banked. It also, however, comprises two other classes of boats which have from time immemorial been used in inland waters. The first of these consists of the state barges, such as that described by Shakspear in Antony and Cleopatra, and those used still by sovereigns and city companies — vessels furnished and equipped in the most sumptuous style and often beautifully ornamented. The other includes the numerous kinds of flat-bottomed vessels of burden used on rivers for the conveyance of goods, and for loading and unloading ships, usually fitted with a large sprit sail to a mast which, working upon a hinge, is easily struck for passing under bridges; such as "ware" barges (presumably originally barges plying on the river Lea or *Ware*), "west country" barges, "sand" barges, "Severn troughs" (a trough from the Anglo-Saxon *troh*, being a small boat broad at both ends), and "light horsemen."[1]

Throughout the Tudor period, and especially during the reign of Elizabeth, the impulse given to commerce by the discovery of America, and of the passage to India by the Cape of Good Hope, contributed to a rapid advance in commercial and naval enterprise, and it was during this period that

[1] *The Sailors Word Book*, by W. H. Smyth, pp. 71-99. *Cf.* also Murray's *Dictionary*.

southern ports, such as not only Bristol and Plymouth, but those of Exeter, Dartmouth, Barnstaple, and Weymouth, which have now become insignificant, acquired importance. In the reign of Henry VII. the London Company of Merchant Adventurers was thrown open to all Englishmen, and in 1603 traded with local companies established at Newcastle, Hull, York, Lynn, Norwich, Ipswich, Southampton, and Exeter, the last-named of which, incorporated in 1560, was largely interested in trade with France and Spain, and claimed an exclusive right to the former.[1] Both Henry VIII. and Elizabeth gave special attention to the conservancy of ports and harbours as well as to shipbuilding, and during the latter reign a commission was appointed by Burleigh in 1568 for the superintendence of ports and havens, and for suppressing piracy, a return being required in each case of all the inhabitants, ships, boats, and vessels in any port or landing-place, with the name and trade of the owners.[2] Mention has already been made of the Acts relating to the Tyne, the Stour, and the Exe passed in the reign of Henry VIII.,[3] and that of Elizabeth is noteworthy both for the construction in 1563 of the first British canal from Topsham to Exeter, which will be noticed later on,[4] and also for the first attempt made to regulate navigable rivers by artificial means. In 1571 an Act was passed for "bringing the river Lea, otherwise called Ware river, to the north side of London" by means of a cut "to be made within ten

[1] *Growth of English Industry*, vol. ii., pp. 243-46.
[2] *Ibid.*
[3] See *ante*, p. 51.
[4] See *ante*, p. 52 note, and *post*, pp. 95-6, 122.

years at the charges of the Lord Mayor, commonalty, and citizens of London, to convey by water all victuals, corn, and other necessaries from the town of Ware to the City of London."[1] The history of Ware, formerly a market town, and still possessing the largest malting business in England, dates back to the ninth century when King Alfred successfully outmanœuvred the Danes, who had brought their ships up to the town, then known as Guare, by diverting the water of the river, and thus stranding their ships. At the time of the compilation of Domesday, where it is called *Waras*, the town belonged to Hugh de Grantemesnil, who founded a Benedictine priory there, and it was successively held, *inter alia*, by the Earls of Winchester, the Wakes, the Nevilles, and the Plantagenets; while the importance attached to maintaining its connection by water with the Thames is shown by the passing in 1430 of the 9 Hen. VI. c. 9, already referred to. The Statute of Elizabeth in effect revived this Act which appointed sixteen commissioners to remove shoals and shallows, the commissioners being representative of Middlesex, Essex, and Herts, and the clearing to be at the charge of the three counties. The commissioners were empowered to take land for the purposes of the Act, and if any owner should "refuse to be reasonably compounded with for ground to be taken" under the Act, they, or a majority of them, must "appoint and determine the composition and bargain between both the parties and the satisfaction for such ground, and all ways, bridges, and other things to the same pertaining." The Lea has thus the distinction of being the first English river to

[1] 13 Eliz. c. 18.

which both improvement Acts and Acts for making rivers navigable applied,[1] and in 1613 it was for the first time utilised for the purposes of water-supply by the company founded by Sir Hugh Middleton for conducting the New River to London. In 1868, various subsequent conservancy Acts relating to the river, which had been previously amended by the Lea Navigation Improvement Act 1850,[2] were consolidated, and the present Lea Conservancy Board, which comprised representatives of the New River and East London Water Companies—whose undertakings have now passed to the London Water Board—was appointed, and provision made for the preservation both of its flow and purity.[3]

The development of inland navigation initiated under the Tudor dynasty was steadily continued under that of the Stuarts; and the high value which continued to be attached to our waterways is shown by the statement of Lord Hale in his *De Jure Maris* that "as highways by land are called *altæ viæ regiæ* so these publick rivers for publick passage are called *fluviæ regales*, and *haut streames de le Roy*, not in reference to the propriety of the river but to the public use."[4] The Act of Elizabeth with respect to the Lea was followed, more than a half a century later, by the passing

[1] Clifford's *History of Private Bill Legislation*, pp. 448-71.

[2] 13 and 14 Vict. c. 109. As to the improvements executed under this Act see *Description of the Navigation and Drainage Works recently executed on the Tidal Portion of the river Lea*, by Nathaniel Beardmore, M.I.C.E. *Proceedings of Institution of Civil Engineers*, vol. xiii., pp. 241 *et seq.*

[3] 31 and 32 Vict. c. 154. (Lea Conservancy Act, 1868.)

[4] Harg. Tracts, chap. ii., p. 8.

in 1624 of that already referred to for making the Thames navigable from Bercott to Oxford "for the conveyance of Oxford freestone by water to London, and of coals and other necessaries to Oxford, now coming at a dear rate only by land carriage,"[1] It was pointed out in the preamble that "the said passage will be very behoveful for preserving the highways leading to and from the said university and city and other parts thereabouts," which, owing to "the continual carriages by carts," had become dangerous for travellers in winter, "and hardly to be amended or continued passable without exceeding charge." This Act describes the river above Oxford as "already navigable and passable for boats of good burthen and contents," and as "already navigable for barges from London to the village of Bercott in Oxfordshire." Cricklade, the first considerable town on the upper river, which dates from the time of King Alfred, and continued to send two members to Parliament from the reign of Edward I., until its disfranchisement for bribery in 1782; Lechlade, styled in Domesday *Lecelade*, which was constituted a market town by Richard, Duke of Cornwall, the brother of Henry III.; and Wallingford, the castle of which was rebuilt by the Conqueror, and which was represented in Parliament by two members until the Reform Bill, must all have still retained their ancient importance when the Act of 1624 was passed. That of Dorchester, the Roman Dorocina, which was a Saxon Episcopal See in the seventh century, and the site of an abbey in medieval times, had probably begun to decline after the dissolution of the monasteries, which must

[1] 21 James I. c. 32.

also have injuriously affected the prosperity of the majority of the numerous other places on the river's banks where conventual establishments had been in existence for centuries, such as Godstow,[1] in the abbey of which, founded in 1138, Fair Rosamund was buried; Abingdon, the abbey of which, founded by Clissa in 675, was one of the most wealthy and splendid in the kingdom; Streatley, Reading, Medmenham, Hurley, Bisham, Chertsey, West Sheen near Richmond, and Isleworth. On the other hand, though the abbey of Reading (Benedictine) was a house of very great importance, its abbot being one of the spiritual peers of the realm, "ranking with baron or earl of the noblest lineage,"[2] the town, which according to Stow was once called Pontium, on account of the number of bridges over the Kennet, had been a centre of the cloth manufacture as early as the reign of Edward I., and must therefore have suffered much less than other places from this cause. Berks and Wilts were two of the principal counties in which that manufacture was carried on,[3] and Cricklade, Lechlade, Wallingford,

[1] Godstow was a Benedictine nunnery, and Reading and Abingdon were abbeys of the same order. Medmenham was a Cistercian monastery founded in 1200, and Streatley an Augustinian nunnery founded in the reign of Henry II. Hurley, a Benedictine priory and cell of Westminster, was founded in the reign of the Conqueror. Bisham, an Augustinian priory, belonged in the reign of Edward II. to the Knights Templar. Chertsey was a Benedictine abbey, originally founded in 666. Isleworth (Syon Abbey) was founded originally at Twickenham in 1414 by Henry V. for nuns of the order of St Bridget, and removed to Isleworth in 1432. The priory at West Sheen, a now extinct hamlet, was Carthusian, founded by Henry V.

[2] *Henry VIII. and the English Monasteries*, by Dom. F. A. Gasquet, O.S.B., vol. i., p. 26.

[3] The trade was chiefly centred in the west of England during the seventeenth century, and also in Hants, Kent, and Sussex.

and also Maidenhead, which was first incorporated in the reign of Edward III., under the name of Magdenhithe—from the old French *magne* great and *hithe* haven—also probably owed their prosperity to it. Henley, considered by some antiquaries to be the oldest town in Oxfordshire; Windsor, which has been a royal residence from the time of the Conquest, and a parliamentary borough since 1276; Kingston, at which several of the Saxon kings were crowned; and Richmond, then known as Sheen, in the ancient palace of which Edward III., Anne the Consort of Richard II., and also Queen Elizabeth died,[1] no doubt owed their importance largely to their situation on the river.

In his very interesting *History of the Watermen's and Lightermen's Company*, Mr Humpherus says "that the deepening of the navigation from Bercott to Oxford placed London in direct water communication, by means of barges and lighters, with several inland counties, causing a large increase of trade, and the employment of a great number of watermen and lightermen"[2]—a class who, according to Stow, could at any time have furnished 20,000 men for the fleet, and the antiquity of whose calling is evidenced by the recital, in the first Act passed in 1514 for their regulation, that "it had been a laudable custom and usage tyme out of mind to use the river in barge or wherry bote." The use of the Thames as the "silent highway" of London

[1] The palace was burned down in 1498, but rebuilt by Henry VIII.

[2] *History of the Origin and Progress of the Company of Watermen and Lightermen of the River Thames, with numerous Historical Notes* (1514-1859), by Henry Humpherus, vol. i., p. 212.

was just beginning to decline in the time of the Stuarts, owing to the first introduction of coaches—an innovation complained of by John Taylor, "the water poet," himself a waterman, who in one of his numerous pamphlets states that this, combined with the excessive numbers of the craft and the removal of theatres from the Surrey side were "ruining his poor trade."[1]

These causes, however, had probably then done little to diminish the number of the various craft plying on the river—barges both public and private; wherries or "whyries,"[2] worked sometimes by a single sculler and sometimes by a pair of oarsmen; and "tylte" or "tilt" boats[3]—a term derived, like that of "tilt" wagon, from the tilt or canopy erected over the stern sheets—which were manned by four, or more rarely, five rowers and a steersman. All of these were destined to remain in use on the river till the early part of the nineteenth century, and we find that the tilt boat, which was used for carrying goods as well as passengers,[4] had by 1759 been fitted with a slight passenger deck under the tilt after the mast, and that clean straw, renewed

[1] Taylor, whose curious career is described in the *Dictionary of National Biography*, had been "pressed" into the Royal Navy, where he lost both legs. He wrote doggerel verses on all sorts of subjects, and was very popular. He arranged the pageant on the Thames on the marriage of the Princess Elizabeth in 1603, and afterwards visited her when Queen of Bohemia. After taking part in the Civil War on the side of the Crown he took an inn in Phœnix Alley, Long Acre, where he died.

[2] Derived from the Roman *horia*, the *oare* of our early writers. Cf. *The Sailor's Word Book*, p. 729.

[3] *Ibid.*, p. 683.

[4] In 1671 the carriage by tilt boat from Gravesend to London of half a firkin of wine or ale was 1d.; of a whole firkin 2d.; of a hogshead 2s. *Cf.* Humpherus, vol. i., p. 510.

at every tide, was laid at the bottom of the boat, together with a rug or blanket for use in cold or wet weather—improvements which raised the fare per passenger to 1s. or double the amount in the preceding century.[1] The fares payable for the use of all these varieties of boats between London and Gravesend, and London Bridge and Windsor, and intermediate stations had been first fixed by an Act of Philip and Mary passed in 1655, the fare by barge to Gravesend, for instance, being 2d. for each person, "so as the sum of 2d. for every person amount to the sum of 4s."—a proviso apparently intended to limit the number of passengers to twenty-four. The fare by wherry to Chertsey was 1s. 4d., and that by tilt boat to Windsor 10s.,[2] while according to a later list published in 1671, the cost of the last-named journey by barge had then risen to "14s. whole fare and 2s. company," and that of a journey by barge to Gravesend to "4s. 6d. whole fare and 9d. company."[3]

Until this period barges and wherries were, to quote Mr Humpherus, "the only means of conveyance of royalty and the public between the ancient palaces of the Tower, Windsor, Westminster, Greenwich, Whitehall, Sheen, Hampton, and Bridewell, as well as the means of access to and from the splendid mansions of the nobility and gentry when they graced its shores."[4] Bargemen wearing the royal livery formed part of the royal household, and the majority of the nobles and gentry kept barges, beautifully ornamented at great cost, and

[1] Humpherus, pp. 514-15. [2] *Ibid.*, p. 11.

[3] *Ibid.*, p. 515. "Company" here denotes the boat's crew.

[4] *Ibid.* p. 5.

boats, which were moored at the foot of the watergates and stairs leading to the river, and these were a common feature at all the palaces and great houses which then lined the strand and other riverside roads of London.[1] During the sixteenth and seventeenth centuries the Thames was thus the scene of many stately pageants—such as those organised at the marriage of Princess Elizabeth in 1613 to the King of Bohemia; the election of Lord Mayor Parkhurst; the procession by water from Gravesend to Whitehall of Queen Henrietta Maria and Charles I., on the first arrival of the former from France on 14th June 1625; and the great demonstration on the attempted arrest of the five members by the King in 1641.[2]

The first lock used on an English waterway was that on the Exeter canal which, as has been mentioned,[3] was constructed in 1563 by John Trew of Glamorganshire. No attempt, however, appears to have been made to apply the invention to other waterways until the reign of James I., when Letters Patent were granted on 21st July 1617 to John Gason for "a more apt, comodious, and beneficial means for and concerning the framing, contriving, and making of locks, sluices, budges, cutts, etc., etc.," for making "rivers, streams, and waters navigable and passable for boats, keels, and other vessels to pass from place to place."[4] This invention was assigned by Letters Patent of 3rd January 1627 to Arnold Spencer for a term of eleven years, subse-

[1] These watergates were formerly termed "bridges" from the form of their erection.

[2] Humpherus, vol. i., p. 225.

[3] See *ante*, pp. 51-2 notes, and *cf.* pp. 95-6, 122, *post.*

[4] *Patents for Inventions; Abridgments of Specifications relating to Harbours, Docks, Canals, etc.*, A.D. 1617-1866, vol. lxxvii., p. 1.

quently extended by Letters Patent of 11th December 1638 to twenty-one years, with the additional right to the enjoyment for "a terme of fouer score yeares" of all the profits accruing from every river made navigable by him during the continuance of his Patent, subject to annual payment to the exchequer of £5 for every such river,[1] and it appears to have been utilised by him in improving the navigation of the Ouse between Huntingdon and St Neots.[2] It is also, apparently, to another inventor who lived in the same reign, Captain John Gilbert, that we owe the earliest form of the dredger, now one of the most important appliances of modern river conservancy, which is described in the Letters Patent granted to him on 16th July 1618 as a "water plough for the taking upp of sand, gravele, shelves, or banckes out of the river Thames and other banks, harbours, rivers, or waters."[3] As, after the surrender of this Patent on 7th August 1629, Gilbert obtained a new license for the manufacture of these water ploughs in conjunction with James Feese, merchant of London, on 1st July 1631,[4] it seems not improbable that they may have been used in carrying into effect a Proclamation "for cleansing the river Thames of shelves and annoyances, and for the ballasting of ships with sand and gravele thereof,"

[1] *Patents for Inventions; Abridgments of Specifications relating to Harbours, Docks, Canals, etc.*, pp. 3, 5.

[2] See the modern cases of *Simpson* v. *Mayor of Godmanchester*, 73 L. T. 92; 77 L. T. 409; and *Simpson* v. *A. G.*, 91 L. T. 610.

[3] *Fœdera*, orig. ed., vol. xix., p. 304; cf. *Abridgments and Specifications relating to Harbours, Docks, Canals, etc.* (1617-1886), vol. lxxvii., pp. 1-3. Patents for similar objects were issued to Lewis Bayley in 1673, and to Captain John Poyntz in 1693. *Ibid.*, pp. 6-7.

[4] *Ibid.*

issued in 1637 by Charles I.,[1] and also in the execution of two projects for making rivers navigable—apparently the first originated in this country by private enterprise,[2] which were respectively authorised by grants from the Crown made some three years previously in the same reign. The first of these grants was made in 1634 to Thomas Skipwith to enable him "to make the river Soar, dischannelling itself into the river of Trent, portable for boats and barges to the town of Leicester which is a great center of that country";[3] but any works undertaken in pursuance of it must have fallen into decay within the next century, for the first Act relating to the river, which was not passed till 1766, and was limited to the portion of it between Loughborough and the Trent, describes it not as navigable but only as "capable" of being made so.[4] Far more permanent effects have, however, resulted from the second of the grants above mentioned, which empowered William Sandis or Sandys of Fladbury in Worcestershire to make navigable both the Warwick Avon from its junction with the Severn at Tewkesbury to Coventry, and also "the river of Team lying on the west side of Severn towards our town and Castle of Ludlow," which led to the appointment in 1636 of Viscount Campden, Lord Windsor, Lord Spencer, Lord

[1] *Fœdera*, orig. ed., vol. xx., p. 93. This Proclamation refers o a Statute of 27 Hen. VIII. made for "the preservation of the said river Thames."

[2] These attempts to make rivers navigable are distinguished therefore from the case of those above mentioned, in which the work originated in the Crown.

[3] *Fœdera*, orig. ed., vol. xix., p. 597.

[4] 6 Geo. III. c. 94, which was followed by 16 Geo. III. c. 5. *Cf.* Priestly's *History of Inland Navigation*, pp. 611-18.

Brooke, and twenty-six others as commissioners to survey these rivers, and "to compound with all the owners and occupiers of land in their vicinity."[1] Sandys, who was the second son of Sir William Sandys of Miserden in Gloucestershire, and the owner of considerable property in Fladbury, must, indeed, be ranked amongst the first practical exponents of the science of river conservancy. Within three years of commencing his task in March 1635, he succeeded in making the Avon navigable for vessels of from 40 to 50 tons from Tewkesbury to Stratford—a distance of 24 miles by road and nearly 50 by water—and thus provided the inhabitants of the Vale of Evesham with facilities for procuring coal, of which there had previously been great scarcity, wood, iron, and other commodities. Though the heavy cost, amounting to over £20,000, of the navigation works, which comprised thirteen sluices, obliged him to abandon his original intention of making the river navigable to Warwick, and also apparently his projects with respect to the Team, the navigation was eventually carried to its present limit at Evesham during the Protectorate by William Say, one of the king's judges, and on the attainder of the latter after the Restoration it became the property of Lord Windsor, who, during 1664-66 employed Andrew Yarranton, a noted "river engineer" of the period, to reconstruct the portion between Stratford and Evesham. As Lord Windsor settled his rights in the Upper river

[1] *Fœdera*, orig. ed., vol. xx., p. 6. There appears to be no record of this grant (*cf.* Hardy's *Syllabus to Rymer's Fœdera*). As, however, Sandys began his operations the year before the Commission (which apparently was necessitated by local opposition to his scheme) was appointed, some such grant must have been made in 1634 or 1635.

on his youngest, and in the Lower river on his second son, the two navigations have, from that period, been separate properties, and in 1760 George Perrot, one of the Barons of the Exchequer, purchased the Lower river out of Chancery, while the shares in the Upper river passed into the possession of various owners; but since the passing of 24 Geo. II. c. 39, in 1751, the tolls, which had previously been fixed by the proprietors, have been regulated by statute.[1]

Owing, doubtless, to the troubled nature of Charles I.'s reign, and the outbreak of the Civil War, we find no record of any further Acts relating to rivers until after the Restoration, which was followed by a great development of trade and commerce, and a general movement for the organisation of commercial enterprises resulting in the formation of the Hamburg, East India, Levant, and Hudson's Bay Companies. In 1655-56, however, Francis Matthew, who may be regarded as another of the pioneers of the movement for the development of inland navigation, published the two pamphlets already referred to on the subject, which were addressed by way of petition to the Lord Protector and to Parliament. In the first of these[2] he suggested that the Hampshire Avon, from Salisbury to Christchurch, and the Bristol Avon

[1] Cf. *Collections for the History of Worcestershire*, by Treadway Nash, vol. i., p. 446-47, in which the author quotes "an account of the Waterworks of Mr William Sandys of Fladbury on the river Avon, begun in the year 1635," written by the "famous Mrs Elstobb" of Evesham in 1737. See too *A descriptive History of the Town of Evesham*, by George May, pp. 354-58.

[2] *The opening of Rivers for Navigation, the benefit exemplified by the two Avons of Salisbury and Bristol, with a Mediterranean Passage by water for billanders of* 30 *tons between Bristol and London, with*

up to Malmesbury and Calne, should be made navigable for the passage of *billanders* or hoys—flat-bottomed boats drawing only 3½ feet of water when loaded—these boats to be utilised in the case of the latter river for carrying the coal of the Kingswood collieries near Bristol; and also that a cut should be opened from Malmesbury on the Avon to the Isis at Cricklade and Lechlade "and so into the Thames, the land distance being not above 4 or 5 miles, over low and practicable ground most fit for the designs." In the other, he advocated the junction by a "Meditteranean Passage" of the Ouse and the Waveney, which at a place called Lepham Bridge are not more than a mile apart, and the deepening of the Fosse Dyke in order to carry the navigation up to York.[1] "The flourishing Havens of Lynn and Yarmouth are," he says, "so portuous, so much frequented with shipping and so plyed with trade" that the counties of Norfolk and Suffolk "receive much comfort thereby, being more indulgently dealt withal by their two Havens than remoter parts, as particularly assisted by their importations, furnished by that means with many foreign commodities which come flowing into those ports."[2] While water

results. The "bilander" or billander was a small merchant vessel with two masts, particularly distinguished from other vessels of the kind by the form of the mainsail, which was bent to the horizon at an angle of 45°; it was used in Holland for coasting and canal traffic. See *The Sailor's Word Book*, p. 78.

[1] Afterwards presented, like his former petition, to Charles II., and published under the title of "A Meditteranean Passage by water between the two sea towns, Lynn and Yarmouth, upon the two rivers the Little Ouse and Waveney, with further results producing the passage from London to York."

[2] *Cf.* pp. 56-61 *ante.* The Great Ouse was compared by an early writer to the Milky Way: "Via Lactea quæ merces et alia vitæ necessaria infert et defert, ejusque in otio instar clavis Lenn (Lynn)

communication between the two ports would therefore benefit the market towns on both rivers, the repair of the Fosse Dyke would, he maintains, "revive that safe, rich, and large extended commerce which by that means did formerly spread itself within the land," and by connecting York with Yarmouth "to the unspeakable comfort of many towns and villages lying near or upon the Passage," benefit both the east and north of England, "and by participation all England over."[1]

These schemes, despite their obvious merits, received of necessity little attention during the unsettled period of the Protectorate. They were, however, subsequently submitted by Matthew to Charles II. and his Parliament, and may then have contributed to the movement for the improvement of our waterways resulting from the great development of commerce during the seventeenth century, and more especially after the Restoration.[2] Though we may perhaps infer from his pamphlets that he had special qualifications for treating the question, they contain, however, no evidence that he had the practical experience in dealing with rivers possessed by Andrew Yarranton, already mentioned in connection with the Warwickshire Avon, who devotes the greater part of his work *England's Improvement by Sea and Land*,[3] the first part of which was

sedit." *The History of the Ancient and Present State of the Navigation of the Ports of King's Lynn and of Cambridge, and of the rest of the Trading Towns in those parts*, by Thomas Badeslade, 2nd ed., pp. 1, 2, and *post*, p. 83.

[1] *The opening of Rivers for Navigation*, etc., pp. 5-9.

[2] *Cf.* Cunningham's *Growth of English Industry*, vol. v., pp. 193, 214 *et seq.*

[3] *England's Improvement by Sea and Land to Outdo the Dutch without Fighting.*

published in 1677 and the second part in 1698, to demonstrating the advantages to be derived from developing water communications in this country to the same extent as they had for centuries been developed in Holland and France. Yarranton, who had travelled in both these countries, and, after beginning life as a linen-draper's apprentice, and being successively a captain in the parliamentary army, a farmer, and the owner of iron works, eventually appears to have become a sort of consulting engineer,[1] and in that capacity surveyed the Hampshire Avon for Lord Clarendon, who had considerable property at Christchurch, and also as already mentioned, the Warwickshire Avon and several other rivers for Lord Windsor.[2] He drew attention in his work to the neglected condition of the Lea between Ware and Bow, and of the Thames between Oxford and London, comparing the metropolis to the heart, and rivers to the veins of the body,[3] and advocated the improvement of the Thames and Cherwell for the conveyance of corn to London, and various other river improvement schemes, many of which, however, failed through want of the capital required for their execution.[4] Besides surveying, as he tells us, "the three great rivers of England and several small ones,"[5] and constructing the works already mentioned in connection with the Warwickshire Avon, he was also chiefly instrumental in carrying out an Act of 1673,[6] empowering his patron

[1] *England's Improvement by Sea and Land to Outdo the Dutch without Fighting*, p. 193 *et seq*. *Cf*. also *Dictionary of National Biography*, and Nash's *Collections for the History of Worcestershire*, vol. ii., p. 45.

[2] *Ibid*., pp. 40-1, 186, 189.

[3] *Ibid*., pp. 178-79.

[4] *Ibid*., p. 180.

[5] *Ibid*., pp. 193-94.

[6] 13 and 14 Car. II. c. 13.

Lord Windsor, the Earl of Bristol, and Thomas Smith, Esq., to "cleanse, scour, dig, and make navigable" the rivers Stower and Salwey from Stanton to Kidderminster, and giving them the exclusive right of employing barges and boats on the navigation. The three original undertakers, as they are termed, abandoned the work after it had made some progress, and Yarranton, who had initiated the project, and as he says, regarded it "as a brat of his own," obtained an assignment of "a third part of the inheritance to him and his heirs," and completed it himself at the cost of £1000. Among the eighteen commissioners appointed to carry out the Act was Samuel Sandys,[1] a kinsman of the William Sandys of Fladbury, who had made the Warwickshire Avon navigable nearly thirty years before, which perhaps accounts for a provision contained in it that that river "shall be continued, maintained, and preserved," and that all differences regarding it shall be determined by the commissioners.

This Act, the first of a long series for the improvement of rivers, was followed by another passed in the same year,[2] which authorised Sir William Sandys of Ombersley Court, Worcester, who was also apparently collaterally related to William Sandys of Fladbury,[3] and his sons Windsor and Henry Sandys

[1] Probably a member of the Ombersley branch of the family, see note below.

[2] 13 and 14 Car. II. c. 14.

[3] Mr John Lloyd, in his account of these rivers quoted below, identifies Sir William Sandys of Ombersley with William Sandys of Fladbury, and also with the Samuel Sandys above mentioned as commissioners for carrying out the Act relating to the Stower and Salwey, and in this he is followed by Mr Jeans in his *Waterways and Water Transport*. It appears, however, from a pedigree of the family of Sandys or Sandis given in Nash's *Collections for a History of*

to make the Wye and Lugg and "the rivers and brooks, running into the same," navigable between Hereford and the Severn for "barges, boats, lighters, and other vessels," and, as in the case of the Stower and Salwey, vesting in them the exclusive use of all the boats navigating them. The Act is noteworthy on account of the composition of the commission appointed to carry it out, which comprised five representatives from Gloucester, five from Monmouth, and ten from Hereford, and also as providing for the establishment of a weekly service of boats for passengers as well as goods between Hereford and Bristol; but Sir William Sandys was unable to complete the necessary works, and though various subsequent attempts were made to do so it was not until 1694 that the rivers were made navigable under 7 and 8 Will. III. c. 14.[1] The Hampshire Avon was made navigable, in 1664-65, by 16 and 17 Car. II. c. 11, and three other Acts passed in the same session [2] respectively pro-

Worcestershire (pp. 221 *et seq.*), that William Sandys of Fladbury was descended from Sir Miles Sandys of Miserden, Gloucestershire, and that the Ombersley branch traced their descent from a brother of Sir Miles—Edwin Sandys, Archbishop of York. The William Sandys, who made the Avon navigable, appears, moreover, from the pedigree, to have died unmarried; and in addition to this, the great lapse of time—twenty-eight years—between the making of that river and of the Wye navigable would seem to render it impossible that the same person carried out both projects. The authors have, however, been unable to identify Sir William of Ombersley in the above pedigree, which may doubtless be incorrect in some details.

[1] Papers relating to the *Navigation of the Rivers Wye and Lugg*, edited by John Lloyd, jun. These papers contain interesting information as to the Wye before it was made navigable. The Act of William III. was amended by 13 Geo. I. c. 34, and 49 Geo. III. c. 78. See Clifford's *History of Private Bill Legislation*, pp. 472, 474.

[2] 16 and 17 Car. II. cc. 6, 12, 24. The whole of the original works of the Hants Avon were swept away by a flood soon after completion, and though after a survey made by Brindley in 1771, and the

vided for making navigable the *river and sewer* from or near Bristow Causey in the county of Surrey into the Thames; the Medway in the counties of Kent and Sussex; and "divers rivers navigable or otherwise passable for boats, barges, and other vessels." The rivers, specified in the last-named Act, are the Itchen from Alresford through Winchester, and the Test from Stockbridge through Romsey to their junction in Southampton Water; the Mole and Ravensbourne in Surrey and Sussex; the "water-courses running from Wallington Bridge to London and other towns"; and the Great Ouse, with respect to which it was specially provided that "the passage of boats should be preserved as formerly." The "undertakers"—Sir Humphrey Bennet, Sir W. Swann, Nicholas Hudert, Robert Holmes, John Lloyds, John Lawson, and William Holmes—did not, however, interfere with Spencer in the exercise of the powers vested in him by the Letters Patent of 1638 above-mentioned[1] with regard to the last named river, and his rights eventually passed to Henry Ashley who was empowered by a public Act of 1719[2] by which the river is still regulated to "repair and amend the passage for boats, etc., on the Ouse," and by whom the locks constructed by Spencer were rebuilt, and the river further improved.[3]

rejection of his suggestion that a canal should be constructed parallel to it, an attempt was made to repair them, they were finally abandoned on the construction of the canal from Southampton to Salisbury. The tidal portion of the river for 2 miles is navigable by small vessels at spring tides, but the Christchurch bar at its mouth is unpassable at other times, Priestley's *History of Inland Navigation*, pp. 42, 43.

[1] See *ante*, p. 70. [2] 6 Geo. I. c. 29.

[3] See *Simpson* v. *Mayor of Godmanchester*, 73 L. T. 92; 77 L. T. 409; and *Simpson* v. *A. G.*, 91 L. T. 611.

Later Acts of the same reign provided for the improvement of the navigation of the Brandon and Waveney,[1] of that between Boston and the Trent, and of the Wey in the county of Surrey;[2] and for making navigable the river Fal, or Vale, in the county of Cornwall.[3] After a considerable interval, without any similar legislation, the Calder, the Tone in Somersetshire from Bridgewater to Taunton, and the Trent were similarly improved in 1699,[4] the Dee in 1670,[5] and in the latter session also the Larke, or Burn, from Mildenhall Mill to Bury St Edmunds;[6] while the Cam, called Cham or Granta, between Clayhill Ferry and Queen's Mill, the Yorkshire Derwent,[7] the Nen from Northampton to Peterborough, and the Avon from Bristol to Bath, were made navigable in the reign of Anne.[8] On the accession of George I. improvements were made in the navigation of the Derbyshire Derwent, and the Douglas from the Ribble to Wigan,[9] the Weaver,[10] the Don from Doncaster to Tinsley,[11] the Eden as far as Bank End, Cumberland,[12] the Mersey (called Mercy), and Irwell between Liverpool and Manchester,[13] and the Kennet between Reading and Newbury.[14]

[1] 22 Car. II. c. 16.
[2] 22 and 23 Car. II. cc. 25, 26.
[3] 30 Car. II. c. 20.
[4] 10 and 11 Wm. III. cc. 8, 19, 20.
[5] 11 and 12 Wm. III. c. 24.
[6] 11 and 12 Wm. III. c. 22.
[7] 1 Anne cc. 11, 20.
[8] 12 Anne Stat. 2 (Nen), and 10 Anne c. 8 (Bristol Avon). The navigation of the latter river was extended by 47 Geo. III. c. 129, and 51 Geo. III. c. 167. See Priestley's *History of Inland Navigation*, pp. 51, 52.
[9] 6 Geo. I. cc. 27, 28.
[10] 7 Geo. I. c. 10.
[11] 12 Geo. I. c. 38; 3 Geo. I. c. 20; 6 Geo. I. c. 9; 13 Geo. I. c. 11.
[12] 8 Geo. I. c. 14.
[13] 7 Geo. I. c. 15.
[14] 1 Geo. I. c. 24; 7 Geo. I. c. 8; 3 Geo. I. c. 35. *Cf.* also Clifford's *History of Private Bill Legislation*, pp. 472, 474.

This legislation, extending over a period of sixty-four years, thus provided for the improvement of the navigation of sixteen rivers and for making ten navigable; and it will be observed that eight of the former and six of the latter class of navigation Acts were passed during the seventeenth century, and thirteen out of the whole twenty-five during the reign of Charles II. One at least of these Acts, however, that relating to the Hampshire Avon,[1] remained a dead letter, though the claims of the river were again pressed upon the public in a pamphlet entitled *Avona*, by a writer signing himself R. S., published in 1675,[2] in which reference is made to "the many Acts lately passed for making several of our rivers navigable, divers of which are since prosecuted to effect,"[3] and also to a Merchants' Company—presumably analogous to those of Exeter, Southampton, and Hull already mentioned[4]—which R. S. predicts will, if his scheme be adopted, "not only be such in name but will be truly such when they shall receive and export their goods by water at their own doors."[5] Another Act, that relating to the Medway,[6] which was especially favoured by Charles II., who took an interest in all these schemes,[7] and

[1] 17 Car. II. c. 11.

[2] *Avona, or a Transient view of the Benefit of making Rivers of this Kingdom navigable, occasioned by observing the situation of the city of Salisbury upon the Avon, and the consequences of opening that water to trade*—communicated by letter to a Friend at London, by R. S. London. Printed by T. R. and N. T., for John Courtney, bookseller in Sarum, 1675.

[3] P. 5. [4] See *ante*, p. 61. [5] P. 32.

[6] 17 Car. II. c. 12. Later Acts, in addition to 14 Geo. II. c. 26, referred to below, were 32 Geo. III. c. 105; 42 Geo. III. c. 94; and 4 Geo. IV. c. 148. *Cf.* Priestley's *History of Inland Navigation*, pp. 475, 478, 756. [7] *Growth of English Commerce*, vol. ii., p. 533.

which was designed to utilise the river "for the better and more easy and speedy portage" of "iron ordinance, balls, timber, and other materials" for the king's service, and also wool, agricultural produce, and leather, was not carried out until 1739, owing to the death, before entering on their task, of the commissioners appointed to put it into execution. It was, however, revived in that year by 14 Geo. II. c. 26, on the ground that the execution of the scheme would provide for the carriage of "the great quantities of timber growing on the woods of Kent and Sussex . . . which is allowed to be the best in the kingdom for the use of His Majesty's Navy," but which "cannot be conveyed to a market but at a very large expense by reason of the badness of the roads in these parts." Though, however, the projects for the conservancy of other rivers may have similarly been frustrated or delayed through the want of funds lamented by Yarranton, several of these early Acts laid the foundations of systems of conservancy which still exist, as in the case of the Wey, the Waveney, Trent, Tone, Dee, Nen, Irwell, and notably the Calder, which since its junction with the Aire has become the most successful waterway in the kingdom.[1]

The Act for improving the navigation of the Calder, passed in 1698, was the earliest among those

[1] The two rivers (both of which are in the West Riding of Yorkshire, and were first united under the Act of 10 and 11 Will. and Mary c. 8 in 1699), form part of the communication between Hull on the North Sea and Liverpool on the Irish Sea in conjunction with the Leeds and Liverpool, Rochdale, Huddersfield, and other connected canals. It joins a branch of the Don at Snaith and the Barnsley Canal near Wakefield. For the history of the navigation, see Priestley's *History of Inland Navigation*, pp. 7-19.

relating to the northern rivers in the series under consideration; and towards the close of the seventeenth century, during which transport was chiefly required for the products of the surface of the soil,[1] the rivers of the southern and eastern counties began to lose their original importance. On the east coast, as shown by Thomas Badeslade and Nicholas Kinderley—two writers of the period, both of whose works reached a second edition—the outfalls and navigable channels of the Great Ouse, the Nen, the Welland, and other rivers draining into the Wash had been rendered to a large extent impassable through the drainage of the Fens. In 1649 the navigation was so good that, to quote Badeslade, "keels could sail with 40 ton Freight 36 miles from Lynn to Cambridge at ordinary neep tide and as far as Huntington with 15 ton Freight," and that "barges with 10 chauldron of coal could sail up Brandon river to Thetford and as far in proportion up the river Mildenhall." Lynn supplied "six counties wholly and three in part" with "maritime commodities" imported by its merchants, and Bedford, Huntingdon, Ely, Northampton, Peterborough, Mildenhall, Brandon, Thetford, Bury St Edmonds, and Cambridge were all dependent on these rivers; but a severe blow was summarily dealt to the prosperity of all these towns by the erection in 1650 of the Denver Sluice in defiance, as Badeslade with justice contends, of Magna Charta and other statutes prohibiting obstructions in navigable rivers. Its construction was strongly opposed by Lynn and Cambridge, and its injurious effects are clearly demonstrated in a report on the

[1] Cunningham's *Growth of English Industry*, vol. ii., p. 533.

subject made by Col. John Armstrong, Chief Engineer of England, at the request of their respective corporations, which is appended to Badeslade's work; but their protests proved unavailing, and the navigation of the Wash rivers continued steadily to deteriorate till the close of the eighteenth century.[1] In the south, the iron works of Sussex ceased to exist owing to the exhaustion of fuel through the destruction of timber, and were gradually supplanted by those of Shropshire and Staffordshire, in which the pottery industry, first established at Burslem in 1690, was steadily growing into importance. The rivers of Derbyshire, which in the Middle Ages was a thinly populated county, ceased to be neglected when the iron and lead mines of the Peak District began to be thoroughly worked, and the silk manufacture, introduced in 1719, had obtained a sure footing. When the industrial revolution of the eighteenth century began, the eastern counties with their slow flowing rivers were from the first rapidly surpassed by the West Riding of Yorkshire owing to the superiority of the water power provided by the rapid streams of this and other western

[1] See *The History of the Ancient and Present State of the Navigation of the Ports of King's Lynn and of Cambridge, and the rest of the Trading Towns in these parts, and of the Navigable Rivers that have their Course through the Great Level of the Fens called Bedford Level* . . . by Thomas Badeslade, 2nd ed., 1766, pp. 2, 6-14, 98 *et seq.;* and *cf. The Ancient and Present State of the Navigation of the towns of Lynn, Wisbeach, Spalding, and Boston, of the rivers that pass through them and the countries that border thereon* . . . by Nathaniel Kinderley, 2nd ed., 1751, pp. 13, 14, 27, 28, 64 *et seq.* Though agreeing as to the condition of the Wash rivers, these authors differ as to the remedies, Badeslade advocating the destruction of the Denver Sluice (p. 98) and Kinderley the alteration and union in one stream of the river channels (p. 83).

counties. When Liverpool, which first struggled into existence as the port for Ireland, in the reign of John, began to acquire a new importance through the development of the trade with the West Indies and the North American colonies, the Mersey, the first Act of importance relating to which was, as has been seen, passed in 1721, began to vie with the Thames and the Severn. The opening of the Lancashire coal fields, and the foundation of the cotton industry completed the transfer of industrial supremacy from the south to the north of England, and, owing to the success of the canal constructed by Brindley for the conveyance of coal from the Duke of Bridgwater's Worsley mines, it was in the northern counties that the advantages of artificial waterways were first conclusively demonstrated.[1] The increase of the national wealth at the middle of the eighteenth century was so great that the promoters of the new movement were free from the financial difficulties with which Yarranton and the advocates of river improvement had to contend, and they thus successfully inaugurated the new era in the history of water conservancy which will form the subject of the two succeeding chapters.

[1] Cunningham's *Growth of English Industry*, vol. ii., pp. 496, 498, 500, 523. Cf. *The History of some English Shires*, by the late Bishop Creighton, pp. 231-2 ; *cf.* pp. 33, 64, 227 ; and Ure's *Dictionary of Arts, Manufactures, and Mines*, 4th ed., vol. i., p. 1067, vol. ii., pp. 484, 598-99.

CHAPTER VI

THE HISTORY AND CONSTRUCTION OF ARTIFICIAL WATERWAYS

Canals adjuncts to natural waterways. Waterways and civilisation. Canals of the ancients. Egypt. Babylon. Greece and Rome. India. Distinction between ancient and modern canals. Invention of the canal lock the determining feature. Leonardo da Vinci. Canals in Italy. Holland and France. Early British canals. The Fosse Dyke. Exeter Canal the first constructed on modern lines. Rules guiding canal construction. Engineering difficulties compared with those of railway construction. Reservoirs and feeders. Aqueducts. Lock construction. Inclined planes and hydraulic lifts. Dimensions of a canal. Waste weirs and stop-gates.

CANALS, says Mr Vernon Harcourt,[1] are introduced to supply the deficiencies of natural waterways by their construction "in places where rivers are not available, or to provide a passage where

[1] *Rivers and Canals*, vol. ii., p. 469. With reference to the concluding clause of the above definition, it may be mentioned that in this country a range of high land passes, nearly north and south, along its whole length, which divides the springs and rainfalls that flow to the opposite coasts, and which may be called the Grand Ridge—or, as it would be termed in America, "the Great Divide"; and that across this ridge no less than twenty-two of our canals pass, some of them more than once, forming as many navigable connections between the rivers of the eastern and western seas. *Cf.* as to the distinction between canal and river navigation, *The Principles and Practice of Canal and River Engineering*, by David Stevenson, M.I.C.E., 2nd ed., pp. 54, 55.

serious obstacles to navigation exist in a river, or to connect two river navigations by surmounting the water-parting of their basins."

It is a remarkable fact that, in searching for the records of civilisation left by the nations, we invariably find them more amply supplied, and more advanced in character, when referred to dwellers on the seacoast or in contiguity with navigable rivers; and that they supply indisputable proof that such nations have been traders, actuated by the desire to extend their commercial relations—either by sea, with foreign countries, or with their own more immediate neighbours by means of inland navigation. It is not surprising, therefore, to find that, among all the peoples inhabiting the shores of the Mediterranean, pre-eminence in these particulars should have been assigned, by all the ancient historians, to the dwellers in Upper and Lower Egypt—in the former of which provinces the population was nowhere separated by any considerable distance from the main flow of the Nile; and in the latter, had even greater facilities for extending their communication by water carriage afforded by the numerous branches and tributaries which are here characteristic of the river. The fertilising properties of the periodical inundations of the Nile were of course well known and availed of from the earliest times, but it must not be supposed that this provision of nature was absolutely relied upon to supply all requirements without artificial aid. From time immemorial machines have been used to raise the water to grounds above the level of the inundation; lakes were also formed to supply the deficiency, and canals to convey the water to the districts

that required it. Many of these canals or cuts are believed to have been made by Rameses (the Sesostris of the Greeks) who succeeded to the sovereignty in the year 1306 B.C.

According to Savary there were as many as eighty canals in Upper and Lower Egypt. The Grand Canal, between the Nile and the Red Sea was, according to Herodotus, begun by Necos, carried on by Darius, and finished by Ptolemy II.,[1] its dimensions being 37 miles in length, 100 feet in width, and 40 feet in depth. The canal of Alexandria, cut from the Nile by Ptolemy, avoiding the dangerous passage of the Delta, was much used as a source of water-supply to the city, as well as for the purposes of irrigation.

Ptolemy, Pliny, and Strabo all mention the canalisation, in still more remote ages, of a branch of the Euphrates at the confluence of the Tigris near Seleucia, by the Babylonians, "where," says Professor Tytler, "they carried on an extensive trade which enabled them to exchange the excess of the products of their fertile soil, and of their manufactures, for the commodities they required from other countries." Pliny also speaks[2] of the "Fossiones Philistinæ," which appear to have been large canals at the mouth of the river Eridarius in Liguria, a province of Upper Italy: and Herodotus[3] mentions a project of the Cnidians, who inhabited a country called Caria in Asia Minor, to dig a canal across the isthmus that separated them from the continent. The Greeks and Romans, at different times, entertained the project of cutting a

[1] Diod. Sic., lib. i., p. 139. [2] Lib. iii., c. 16.
[3] Lib. i., c. 74.

canal across the isthmus of Corinth,[1] but in both instances the attempt was abandoned. And here it may be observed as somewhat remarkable that two nations who, at successive periods, dominated the ancient civilisation, should have apparently neglected so valuable and comparatively simple a means of extending their commerce, such as a judicious system of canal construction affords. It is true that the Romans, under their general, Drusus, effected a communication between the waters of the Rhine and the Issel, while Lucius Verus attempted one in Gaul between the Moselle and the Rhine, but failed to carry it out; and that in Britain, Agricola, as we have seen, constructed a long cut or canal from Peterborough to the Trent, known as the Caer Dyke, which is still to be traced. But all these undertakings were dictated by a military, rather than a commercial policy, to facilitate the passage of troops and supplies, rather than to subserve the purposes of trade and commerce.

If we turn to the Far East, there is evidence to show that the primitive Bengalee had learned to appreciate the beneficent influence of "Mother Gunga," the Ganges, on his native soil, and that in many a desolate tract he had trained her to his service, and brought her fructifying waters to his rice fields. In later times also it is on record that the Mogul Emperor, Feroze III., who died in 1388, had a project for joining the Sutlej and the Jumna by a canal route of 240 miles in length. The teeming millions of "far Cathay" are probably to be reckoned among the earliest peoples who cultivated

[1] Pliny, lib. iv., c. 4.

the science of inland navigation by artificial means. It is said that there is scarcely a town or village in that vast empire that has not the advantage of either an arm of the sea or a canal, by which means navigation is rendered so common, that almost as many people live on the water as on the land. Moreover many of these canals are believed to have been constructed at a very early period. It is certain, however, that the Imperial Canal, which runs north and south, and was completed in the year 1289, extends from Canton to almost the verge of the empire, and that by it foreign goods and merchandise have for centuries been conveyed to Pekin at a distance of 825 miles.[1]

Remarkable, however, as they are as engineering works, it cannot be doubted but that these early efforts in the construction of artificial waterways bore a very faint resemblance to a modern canal, designed as those of Africa and India were principally for purposes of irrigation, and but partially adapted to fulfil the objects proposed in Mr Harcourt's definition at the head of this chapter. Not till the invention of the canal lock, which enabled vessels to be transferred from one level to another, could inland navigation be said to have attained its utmost possibilities, or to be generally capable of extension. The actual author of this great invention, or even the country in which it originated, cannot be stated with precision, though the most general belief is that either the Dutch or the Italians

[1] *Cf.* Art. "Canal" in *Encyclopædia Britannica.* For further information respecting the canals of the ancients, *cf.* also Philip's *History of Inland Navigation*, 4th ed., pp. 1-24; and Macpherson's *Annals of Commerce*, vol. i., pp. 434, 457, 458.

must be awarded the distinction. In Holland and Flanders however it must be remembered that to this day the canals are mostly on one level and without locks, and moreover that some of the largest canals in the country were cut as early as the twelfth century, whereas the earliest date that has been assigned to the invention is the year 1488. This latter date coincides with the residence at the court of Ludovico Sforza, Duke of Milan, of that universal genius Leonardo da Vinci, who entered himself a member of the academy for architecture which his patron had established. "About this time," says the author of a life of Leonardo prefixed to his *Treatise on Painting*,[1] "Duke Lewis formed a design of supplying the city of Milan with water by a new canal. The execution of this project was deputed to Leonardo, and he acquitted himself of the trust in a manner that surpassed all expectation. The canal goes by the name of Mortesana, being extended in length above 200 miles: and, navigable throughout, it passes through the Valteline and the valley of Chiavenna, conducting the waters of the river Adda to the very walls of Milan, and enriching both the city and the adjacent campaign by its communication with the Po and the sea. This was a noble and a difficult enterprise, every way worthy of Leonardo's genius. He had here several difficulties to grapple with, much beyond what had been met with in digging the ancient canal which conveys the waters of the

[1] *A Treatise of Painting, by Leonardo da Vinci, translated from the original Italian and adorned with a great number of cuts, to which is prefixed the Author's Life, done from the last edition of the French; London, printed for J. Senex at the Globe in Salisbury Court*, 1721.

Tesino to the other side of the city, and which had been made above 200 years before, while Milan was a republick. But Leonardo surmounted all opposition, and happily achieved what some may think miraculous, rendering *hills* and valleys *navigable* with security." Moreover, in support of the theory that attributes the invention of the lock to Leonardo, it may be stated that he left a treatise "on the nature, *equilibrium*, and motion of water," which contains drawings of "machines for conveying, *raising*, and *supporting* of water; being written on occasion of the aqueduct at Mortesana."[1]

Be this as it may, however, it cannot be doubted but that the invention must have revolutionised the art of canal construction, and have acted as an extraordinary stimulus to engineers and promoters of public works throughout Europe; and during the sixteenth century many important works, notably the Brussels Canal, extending to the Scheldt and completed in 1560, were undertaken. In France, in addition to the canal of Briare or Burgundy begun under Henry IV. and finished under Louis XIII. (1610-1642), connecting the Loire and the

[1] M. de la Lande, in his *Traité des Canaux de Navigation*, says that the first lock was supposed to be erected in the year 1488 on the river Brenta near Padua, and that, shortly after, the two canals of Milan, between which there was a fall of nearly 34 feet, were joined by six locks similar in principle to those now in use. Cf. *The Improvement of Rivers*, by B. F. Thomas, U.S., Assistant Engineer, M. Am. Society of C.E., and D. A. Watt, U.S., Assistant Engineer, M. Am. Society of C.E., p. 146 *et seq.*, where the authors quote a statement in the *Annales de Ponts et Chaussées* for 1847, that the first lock was made by Visconti in 1439 to connect two lakes for the purpose of facilitating the transport of marble for Milan Cathedral. The first lock constructed in England was built by John Trew on the Exeter Canal, see *post*, pp. 95-6.

Seine, and the canal of Picardy connecting the Somme and the Oise, the great Languedoc Canal, which connects the Atlantic and the Mediterranean, was commenced in 1666, under Francis I., and completed in 1681 under Louis XIV. This great undertaking, which in grandeur of conception, difficulty of execution, and importance of results may be said to be without parallel, is 180 miles long, 144 feet wide, and 6 feet deep, and was long regarded as a model both of design and workmanship.[1]

In this country, owing to industrial conditions which have been already indicated, considerable delay occurred before we seriously set ourselves to copy the excellent example set by our neighbours. And this is the more remarkable when we reflect that so long ago as 1121 Henry I. had deepened and rendered "partially navigable" the old Roman Fosse Dyke, which, in a sense, may be called the first British Canal. Macpherson in his *Annals of Commerce* says that "inland trade was assisted not only by the many navigable rivers which intersect England, but also apparently by artificial canals," and he adds that Abbo of Fleury describes

[1] Holland undoubtedly led the way among European nations in canal construction, and not only that country, but also France (as we have seen), Sweden, and Russia had all provided themselves with systems of artificial waterways before any similar works were undertaken in England. *Cf.* Smiles' *Lives of the Engineers*, vol. i., p. 300. For an account of the canal systems of the Continent, *cf.* also the *History of Inland Navigation*, 4th ed., pp. 25-83. In Russia, Peter the Great ordered the construction of a canal to connect the Caspian and Black Seas, which was carried out under the direction of an Englishman, Captain John Perry, who also partly constructed another between the Volga and the Don, a project which was stopped by the taking of Asoph by the Turks. Macpherson's *Annals of Commerce*, vol. ii., p. 728.

the kingdom of the East Angles as bounded on the west by a rampart and ditch, and that several similar ones are mentioned in Camden's *Britannia* as being in Cambridgeshire. A canal in Huntingdonshire called Kingsdelf referred to in the *Anglo-Saxon Chronicle* is, he says, at least as old as the year 963, and he suggests that "these canals may be of still higher antiquity and may owe their origin to Roman policy and British labour."[1] Whether these so-called canals were available for navigation or were merely for drainage purposes may be doubted, but no such uncertainty exists with respect either to the Caer Dyke mentioned in the last chapter or the Fosse Dyke, a canal 7 miles in length constructed by Henry I. from Torksey on the Trent to Lincoln on the Witham, both of which are described by Camden in his *Britannia.*[2] Francis Matthew, who advocated the repair of the Fosse Dyke in a pamphlet published in 1656, observes that "Mr Camden saith this gallant king caused that memorable work of 7 miles to be cast up for the benefit of his city of Lincolne, though other writers speak of a mixt intention therin, as partly to facilitate his own Removals from one part of the kingdome to another; he being the first who brought Progresses into fashion, so making his people equally participant of him that they might see and know him better by himself than by his picture . . . Howsoever his ends were it was a noble work, and a gift worthy to come from the

[1] Vol. i., p. 289.

[2] Gough's *Camden*, vol. i., pp. 227-52. *Cf.* also as to the Caer Dyke, *ibid.*, pp. 234, 242, 252, and Priestley's *History of Inland Navigation*, p. 294. This must not be confused with the Fosse navigation, partly river and partly canal, in Yorkshire, designed by Jessop early in the nineteenth century, see *ibid.*, p. 291.

Crown, it being *the first President* [*sic*] *that I have found in England of joyning Rivers for Navigation*, which sheweth even then how forward and prone towards Improvement this Kingdom was." Some centuries later Smeaton and Grundy who were called upon, in 1762, to report upon this navigation, found it but 2 feet 8 inches in depth; and though the idea of deepening it was at the time discouraged, it was, in 1782, deepened to 3 feet 6 inches under the direction of the former. In 1840 Stevenson was employed to assimilate it with the navigable portion of the Witham, when it was found to be 3 feet 10 inches deep, and it was then widened to 45 feet, and made 6 feet deep throughout, while at the same time the entrance lock at Torksey was renewed, at a total cost of £40,000.

In the meantime an Act had been obtained in 1755 for making Sankey Brook navigable from the Mersey to St Helens, an undertaking which, according to Macpherson,[1] was due to the "commercial and enterprising inhabitants of Liverpool," but which was afterwards abandoned in favour of an entirely new canal with locks. This work, which was completed in 1760, is by many wrongly regarded as the first navigable canal made in England, but a pound lock canal from Topsham to Exeter, similar in all essential points to one of the present day had been already constructed in 1563, more than a century and a half before, by "John Trew of Glamorganshire in Wales, Gentleman"—as he is described in the Agreements on the subject—for the

[1] *Annals of Commerce*, vol. iii., p. 331. *Cf.* also, as to early canals in England, the *History of Inland Navigation*, 4th ed. pp. 86-7.

corporation of Exeter. On account of the failure of many attempts made at a considerable cost to improve the navigation of the Exe under the Act which, as mentioned in a previous chapter,[1] had been obtained for the purpose in 1540, Trew made a canal 9360 feet in length and with a width of 16 feet and a depth of 3 feet throughout, which was afterwards extended to Topsham by operations begun in 1675, but which, owing to the difficulties caused by the soil and the great expense incurred, were not completed till 1703. Between 1820 and 1830 the canal, which for many years previous to the former date had been only capable of passing vessels drawing 9 feet of water from the tideway of the Exe about a mile above Topsham to the quays in the river at Exeter, was still further improved by increasing its depth to 15 feet and by the construction of an entrance lock at Turf adapted for vessels drawing 14 feet of water and of a new basin for their accommodation at Exeter—works which at the end of the fifteen years following their completion had had the effect of trebling the revenue derived from the waterway.[2] Like that of the Fosse Dyke, this recent development of the Exeter Canal belongs, however, to the later stages of the phase in the history of inland navigation which we are about to consider. What may be called the "Canal Era" began with the construction by Brindley for the Duke of Bridgwater of that for connecting the coal

[1] See pp. 51-2 *ante*.

[2] Cf. *A Memoir of the Canal of Exeter*, by Philip Chilwell de la Garte, with a continuation by James Green, M.I.C.E., in *Proceedings of the Institute of Civil Engineers* (1845), vol. ii., pp. 90-113, and the remarks of Sir John Rennie, at the Annual Meeting of the Institute in 1846, vol. v., p. 31.

pits of the latter at Worsley with the city of Manchester. But before proceeding to describe its rise and development, it may be useful to place before the reader a short summary of the general principles followed in canal construction, in order that he may duly appreciate the difficulties that have been overcome by our engineers in the past, and which must still be faced in the future if any effective unification of our complicated system of waterways is to be brought about.

In the construction of a canal or waterway there are certain physical difficulties which at the outset confront the engineer, and render his task far more onerous, and call for greater fertility of resource, if not greater natural gifts on his part, than that of constructing a road or a railway. In both the latter instances the material to be manipulated is before him, or can readily be brought, as required, from his base of operations, and moreover is not in itself liable to waste, either from natural causes, or through the means of transit employed. The canal engineer, on the other hand, has to deal with a more fleeting and subtle element, and to make its constant supply and maintenance his first consideration. He must carefully study in this particular the resources of the country through which he intends to operate, ascertain what natural sources of supply may exist in the shape of lakes or streams, and if these are wanting, must construct artificial reservoirs for the storage of water, which must command a sufficient area of drainage to supply the waste that is constantly occurring by evaporation, leakage, and lockage. The feeders or "offlets" from each reservoir must be at such an elevation as to convey water to the top-

level of the canal. The subsoil, not only of the reservoirs but also of the channel itself,[1] will become a matter for grave consideration, since upon its retentive powers, or the reverse, will depend the measures to be adopted to prevent undue leakage. And finally all calculations must be made in view of the water-supply lasting over the driest season of the year.

In laying out the lines of a canal, the engineer is again far more circumscribed than he would be if called upon to construct a road or a railway, in which case gradients adapted to the undulations of the country can be employed. But a canal must usually skirt the bases of the hills, to avoid the tedious and costly process of tunnelling, and follow the windings of the valleys, so as to preserve, as far as possible, a uniform level. Canals are frequently carried over roads, railways, and rivers by means of aqueducts resembling ordinary bridges, with the exception that the superstructure has to be made suitable for holding the water channel, and its side walls, one of which carries the towing-path, sufficiently strong to resist the pressure of the water. The first of these constructed in England was the Barton aqueduct carrying the Bridgwater Canal across the Irwell at a height of 39 feet, which was made in 1760, and the same canal is now carried across the Manchester ship canal by the Barton swing aqueduct, the first of its kind.[2] Tunnels, similar to railway tunnels, save that they must necessarily be level

[1] Where a canal is excavated through porous soil it has to be made water-tight by a layer of clay, concrete, or other suitable material. Vernon Harcourt's *Rivers and Canals*, vol. ii., p. 354.

[2] Cf. *Rivers and Canals*, vol. ii., pp. 360-61.

from end to end, are sometimes used for conducting canals, especially at their summit level, from one river basin to another, the dimensions being regulated by the depth of water, the headway necessary for the barges, and the width of the channel and the towing-path; such as the Harecastle Tunnel at the summit level of the Trent and Mersey Canal constructed in 1766, which is $1\frac{2}{3}$ miles long, 12 feet high, and $9\frac{1}{4}$ feet wide. Of the nine other tunnels on canals over a mile in length, the longest is the Standedge Tunnel on the Huddersfield Canal, piercing the ridge dividing the Tame and Colne valley, which is $3\frac{1}{10}$ miles long, the one nearest to it in length being the Sapperton Tunnel $2\frac{1}{6}$ miles long on the Thames and Severn Canal, which passes through the ridge lying between the two river basins.[1] "The bridges, aqueducts, tunnels, and culverts incidental to the construction of canals are," says Mr Vernon Harcourt, "very similar to the works required in the formation of railways; and the canal engineers of the eighteenth, and earlier portions of the nineteenth centuries, acted as pioneers in these works and greatly facilitated the subsequent development of railways."[2] The canal that has the greatest number of level reaches will necessarily be the cheapest to construct, as well as to maintain. The invention of the lock having enabled vessels to be expeditiously transferred from a lower to a higher level, and *vice versâ*, it is not surprising to find that, with comparatively few modifications, its principle has remained intact to the present day,[3] although other

[1] *Rivers and Canals*, vol. ii., pp. 462-63. [2] *Ibid.*, p. 372.

[3] The features of the ordinary lock, which has been in use "from time immemorial," are, as Mr Saner observes in his Paper read at the

methods, which will be alluded to later on, have been adopted with success for effecting the same object. It may therefore not be out of place to describe briefly the *modus operandi*, familiar though it must be to a majority of our readers.

A lock is the connecting part between the two reaches of a canal that are on different levels, and this part, which is called the "chamber," can at pleasure be made to coincide with either the upper or the lower level by means of two pair of gates, one at each end of the chamber, in which gates, or through the side walls of the chamber, small sluices are provided by which water can be let in from the *higher* level to *fill* the chamber to the upper level, the lower gates being close shut, or to *empty* the same to the level of the *lower* reach, the upper gates being shut. On the arrival of a vessel at the lock from the lower level, there is no difficulty, if the lock is unoccupied, in opening the lower gates, because the water in the chamber is level and at rest. The lower gates are then shut, the water let in through the sluices from the higher reach, and the vessel rises to the higher level, when the upper gates can easily be opened, the pressure of the water being equal on both sides of them.

Birmingham Conference on *Inland Navigation*, 1895, "so well known as hardly to need description, and that for a moderate fall, up to 18 feet, it would be difficult to improve them." Devices for mitigating the rush of water in deep locks, when the sluices are opened, have been introduced, in which the orifices for filling and emptying have been distributed over the bottom and side walls; and in new work, where masonry has largely supplanted wood, this has been found to succeed. Also, for the purpose of opening the sluices or culverts, winches worked by hand, or even steam power, have entirely superseded the old "ratchet and crowbar" system, which perhaps even yet survives on primitive navigations such as the Wey in Surrey.

The waste which this operation entails, and which is technically termed "lockage," occurs from the fact that "*up* traffic consumes more water than *down*, for the reason that an ascending vessel displaces a volume of water equal to its submerged capacity; the water so displaced flows into the lower reach of the canal, and the lower gates are closed; the vessel is then raised, and, on passing into the higher reach of the canal, its displacement, lost on entering, is supplied by water withdrawn from the higher reach. A descending vessel similarly displaces a volume of water equal to its submerged capacity, but the water in this case flows back into the higher reach, where it is retained when the gates close."[1]

It is hardly necessary to observe that the canal with fewest locks will be the cheapest to construct and the most expeditious to work. In a hilly country, where the levels are frequently changing, much time is consumed in "locking through." Much also depends on the depth of the lock, for when this exceeds from 15 to 18 feet, which is considered a moderate fall, the rush of water is so great that the danger to small craft is considerable, while the larger vessels, violently bumping against the sides and gates of the lock, injure both themselves and the structure. As regards waste in general—it has been estimated that the daily waste of water in British canals through leakage in the

[1] *Cf.* Art. "Canal," *Encyclopædia Britannica.* Fulton states that 25 ton boats going through 8 ft. locks will consume about 163 tons of water in ascending, and 103 tons in descending. As to the dimensions and varieties of canal locks, which it would be beyond the scope of this work to examine in detail, cf. *Rivers and Canals*, vol. ii., chap. xvi., p. 374 *et seq.*

channel and evaporation is equivalent to a depth of 2 inches over the whole surface of the canal, and that arising from leakage at the lock-gates is from 10,000 to 20,000 cubic feet per diem.[1]

The other methods by which two different levels on a canal may be bridged are the inclined plane, and the hydraulic elevator or lift, both of which processes effect a considerable saving of water. The former device was introduced so long ago as 1789 on the Ketling Canal in Shropshire, and has been largely availed of on the Morris Canal in the United States. It may be described, in Mr Saner's words, as a "ship-railway, by which a large tank full of water, supported on wheels, is drawn up an inclined railroad, or the boat is drawn out of the water and carried in a cradle."[2] The hydraulic elevator or lift, "in which the tank is supported and lifted vertically by means of hydraulic power actuating a single ram,"[3] is a still more powerful and efficacious engine for overcoming the difficulty on a large scale, the first having been built at Anderton in 1874-75 by the Weaver trustees, on the advice of Mr (now Sir) E. Leader Williams. "This lift," Mr Saner continues, "raises and lowers the canal boats through a height of 50 feet between the river Weaver and the Trent and Mersey Canal, being connected with the latter by a wrought-iron aqueduct, The boats are enclosed in a water-tight trough. and remain afloat during the whole operation. . . . The caissons or troughs are capable of holding two

[1] Cf. *Rivers and Canals*, vol. ii., p. 371.

[2] *Cf.* Paper by Mr J. A. Saner, read at the Conference on Inland Navigation, Birmingham, Feb. 12, 1895.

[3] *Ibid.*

of the narrow boats in use on the canal, and the operation of entering, lowering, and opening the gates, and passing out, can be performed in from ten to twelve minutes. The waste of water is 6 inches deep over the area of the trough, eleven-twelfths of the stroke being performed by means of the weight of this water, and the remaining power being supplied by a small engine working an accumulator. As the lift has two troughs which are in equilibrium until the 6 inches extra of water is put in, one always ascending, and the other descending, it is ready for either up or down traffic, and when vessels from both sides arrive at once it acts as a double lock."[1]

As regards the dimensions of a canal,[2] it is important that the sectional area should be ample, since the greater the proportion which the sectional area of the waterway bears to that of the boat, the less will be the resistance. It is much to be regretted that in this country no standard dimension has ever been fixed, as has been done in

[1] *Cf.* Paper by Mr J. A. Saner, read at the Conference on Inland Navigation, Birmingham, Feb. 12, 1895.

[2] The trench excavated for a canal is generally formed with a flat bottom, and sloping sides with a minimum inclination of 1½ to 1 ft. except through rock, and the width and depth are regulated by the size of the largest vessels to be provided for. While the ordinary dimensions of the chief English canals are 5 feet in depth, 25 feet bottom width, and 40 to 45 feet surface width, some of the small ones were only 3½ to 4 feet in depth with a bottom width just sufficient to allow two barges to pass; but some of the more important early canals, such as the Monkland, Glasgow and Paisley, and Forth and Clyde canals had a depth of from 8 to 10 feet. The Gloucester and Berkeley and Caledonian ship canals constructed in the early part of the nineteenth century were made of depths of from 18 to 20 feet, and surface widths of from 86½ to 123½ feet, while the Manchester ship canal is 26 feet deep with a bottom width of 120 feet. Cf. *Rivers and Canals*, vol. ii., pp. 351-52.

France, where it is—for the bottom width 32½ feet, depth 6½ feet, and sectional area about 297 square feet. "This standard canal," says Mr Saner, "would not be applicable in England on account of the size of the existing boats, and in 1893, in a paper read by the writer before the Liverpool Engineering Society, he advocated that the English standard for canals should be 40 feet bottom width, 64 feet top width, 8 feet depth, and 416 square feet sectional area. Such a canal would accommodate vessels 75 feet long, 18 feet wide, 7 feet deep, and of about 210 tons displacement."[1]

It remains to mention two very important items in the "agenda" which the canal constructor will have to provide for, namely—waste weirs, and stop-gates. The former are necessary to carry off the surplus water that accumulates during floods. They should be placed at the summit water level of the canal, so that in a flood the water may flow over them and relieve the banks. Their number and position will depend upon the nature of the country through which the canal passes.[2] Stop-gates are necessary to isolate any particular reach of the canal where a fault occurs, and should be set up

[1] *Cf.* paper above referred to.

[2] Cf. *Rivers and Canals*, vol. ii., p. 360. *Cf.*, too, as to earlier methods of canal construction, *The Encyclopædia of Civil Engineering Historical, Theoretical, and Practical*, by Edward Cresy, new ed., 1856, pp. 15-33 *et seq.* The author in his preface observes that:—"Canals, though now superseded by railways, ought not on that account to be entirely neglected; for should steam navigation be still further improved it is not improbable that the data which have occasioned their disuse may prove more favourable for their future construction, and hence the principles which belong to their formation should be thoroughly understood by the civil engineer, as there are many localities where canals would have a decided preference over railways."

at intervals of a few miles apart, so that if necessary the water in the intervening spaces can be run off. For this purpose offlets or pipes, leading from the bottom of the canal, can be directed into any river or stream near which the canal passes. The isolation may be effected by the erection of a single pair of lock-gates.

CHAPTER VII

THE CANAL ERA IN ENGLAND AND WALES

Industrial progress during eighteenth century hampered by difficulties of land transport. Canal construction favoured by neglected state of navigable rivers. The Bridgwater Canal. Brindley. The Duke of Bridgwater. Opposition to the canal system. Richard Whitworth. The Grand Trunk Canal. Other canals laid out by Brindley. Smeaton, Rennie, and Telford. Welsh canals. First ship canal. The Gloucester and Berkely Canal. The Manchester ship canal.

It was apparently not till about the middle of the eighteenth century that our political economists had fully realised the fact that *distribution* is the handmaid of *production*, and that any accession of producing power must be met by a correspondingly enlarged capacity for distribution.[1] While the growth of commerce had been promoted by the encouragement given by the State to shipbuilding, the con-

[1] In the reign of Edward III., we find the State endeavouring to suppress distribution by enacting that the publicans of Yarmouth, who acted in this capacity for the fish trade, were to make no more wholesale bargains with the fishermen, and that the latter were to be assured of the full prices obtainable in an open market. Experience soon showed, however, that the fishermen could not leave their boats and nets to attend an open market; and the king and Parliament, wisely recognising the necessity of the distributor both to the producer and to the public, repealed their well-intentioned Act. *The Unseen Foundations of Society*, pp. 87, 529.

servancy, to a somewhat limited extent, of ports and harbours, and the privileges granted to the great trading companies and guilds, that of inland trade continued to be hampered by the heavy expense of land transport resulting from the neglected condition of highways which, as was shown in a preceding chapter, was often one of the principal reasons assigned for the passing of river improvement Acts.[1]

The great advance made by this country in manufactures, and the establishment of her commercial prosperity, may thus be said to date from the period when, as we have seen, the mercantile world of Liverpool were casting about for means to connect St Helens with the Mersey, and the far-reaching commercial instinct of Francis, Duke of Bridgwater, aided by the genius of Brindley, was evolving schemes for the better and more expeditious distribution of the mineral wealth on his estates. During the seventeenth century, as has already been stated, navigable rivers sufficed fairly well as substitutes for highways because the products of the surface of the soil were the principal staple of internal trade, but during the first half of the eighteenth century, and before ever a sod had been cut under Brindley's direction, the inadequacy of this means for dealing with the increased traffic in coal had already begun to be strongly felt.[2] The facilities for water transport had, no doubt, been greatly

[1] See *ante*, pp. 64, 72, 82.

[2] The cost of conveying coal by "packhorse" from Worsley to Manchester had been as much as from 6s. to 8s. per ton; and was, by the opening of the Bridgwater Canal, reduced to 2s. 6d. *Cf.* Mr H. Gordon Thompson's *Canal System of England*, p. 11.

extended by the numerous Acts already referred to enabling the commissioners and conservancy authorities appointed under them to improve the river navigations under their charge by deepening, straightening, and embanking them, erecting jetties and sluices, making flashes for surmounting the shallows and rapids, and constructing pound locks. Despite this, however, the frequency of shoals in rivers, and especially in rapid ones; their deficiency of water in times of drought, and the destruction which, in time of flood,[1] they caused to works erected for the preservation of the navigation—as was the case on the Avon between Christchurch and Salisbury; the serpentine course of some rivers, and their varying channel; the labour of towing against stream[2]—all these various defects of our natural waterway system were felt to be sufficiently serious to justify in some cases their partial canalisation, and in the majority of others their use as feeders to the new system now so brilliantly inaugurated. The dilatory methods employed, and the imperfect execution of the works undertaken by the various bodies charged with the improvement of river navigations, must also be taken into account in

[1] *Cf.*, as to this, Richard Whitworth's *Advantages of Inland Navigation*, published in 1766.

[2] In this country most of the navigable rivers were without horse-towing paths till the early part of the nineteenth century. At that time it was not uncommon to see fifteen or twenty men hauling at a barge in Twickenham meadows. Tow paths on the older navigations were continually interrupted and broken off; and on the Ouse below Bedford this occurred at the end of every field, where high stiles were erected which the unfortunate horses, hampered by their harness and the line, were compelled to leap. Fields and crops were injured by the horse tracks leaving the riverside in order to cut off a bend, and the banks were destroyed by the frequent necessity for hauling so far from, and so obliquely to the direction of the current. *Cf.* Rees' *Cyclopedia*, 1819, Art. "Canal."

seeking for a reason for the favour extended to the new projects of canal construction. It was not till September 1805 that notices were served by the Upper Thames navigation commissioners of their intention to erect, under the advice of their engineer, Mr Zachary Allnutt, weirs and locks at Laleham, Littleton, Sunbury, and Shepperton;[1] nor is there any evidence to show that navigations of equal, or perhaps greater commercial importance, such as the Severn, Humber, or Mersey, had been more successfully or expeditiously treated.

The Bridgwater Canal, though not absolutely the first in point of time, has always been regarded as the pioneer and model for similar undertakings, and the description given of it in the *Annals of Commerce* by Macpherson, shows the admiration with which it was still regarded some forty-five years after its construction. After stating that the Duke had obtained two Acts of Parliament in the years 1758 and 1759 in order to procure cheap conveyance by water to Manchester, and thus turn to account "a large mountain" of coal upon his estate at Worsley, hitherto rendered a useless possession by the great expense of carriage to market, he says:—

"While he was concerting his plans he perceived, encouraged, and availed himself of the wonderful talents of the uneducated but heaven-taught engineer Brindley, by whose ingenuity, with the abundant supply of materials from his own lands, and a vast expenditure of money for labour, he completed a navigable canal of 29 miles in length, with about 4½ feet depth of water, without any locks; the

[1] Cf. *Considerations on the Best Mode of Improving the River Thames*, by Zachary Allnutt, 1805, p. 22.

inequalities of the ground, and the interventions of rivers and public roads, being surmounted by stupendous mounds of earth, by a tunnel cut through a hill 50 feet under the surface, and in some places hewn out of the solid rock; by aqueduct bridges over the public roads; and by what even professional men then pronounced impossible, an aqueduct bridge over the navigable river Irwell at the height of 38 feet above its surface, which presented to the wondering spectators the new and surprising sight of vessels sailing aloft in the air, high above other vessels sailing below in the river. As the Duke's operations were carried on with great spirit during the whole of this year, the public were gratified with the sight of the first boat passing along his magnificent aqueduct on the 17th July 1761; and the scoffers, who in derision of this noble effort of Brindley's bold but unerring genius, had called it *a castle in the air*, felt themselves ashamed. The whole work of the canal was executed in a style of solidity and grandeur which might induce an inattentive spectator to suppose that it was made for ostentation; but a careful inspection will show that every part is not only proper but necessary, that economy has been happily combined with magnificence, and that the vast expense of perhaps the greatest work ever undertaken and executed in any part of the world at the charge of one individual is small when compared to the extensive utility of it. The Duke, immediately after the completion of this canal, extended the length and the benefits of his navigation as far as Liverpool; and goods are now carried on his canals between that town and Manchester at 6s. a ton instead of 12s., the charge

of the former navigation on the Mersey and the Irwell, or 40s. the price of the land carriage; and while his spirited and patriotic enterprise is rewarded by a vast revenue arising from his water carriage and his formerly useless coal mine, the surrounding country is benefited at least a pound for every shilling paid to the Duke."[1]

The description of Brindley, the most interesting personality in the history of inland navigation, as an "uneducated but heaven-taught engineer," though it may provoke a smile in the fastidious twentieth-century reader, is singularly appropriate. The son of a small Derbyshire farmer, he remained to the last entirely illiterate; but despite his want of general education his remarkable mechanical genius was highly cultivated, and it was combined with no less wonderful powers of observation and intuitive perception, invincible determination, and great fertility of resource. Though when first apprenticed in 1713, at the age of seventeen, to a millwright at Sutton, near Macclesfield, he displayed such indifferent ability that his master, Abraham Bennett, once threatened to cancel his engagement, he soon succeeded in impressing the latter so greatly by his capacity that he eventually placed him in charge of his business. When he first started as a mechanical engineer on his own account at Leek—where he was at one time employed by the Wedgewoods, then small potters—his inventive genius appears to have been largely devoted, without much success, to improvements in connection with Newcomen's steam engine; and he had therefore had no experience of

[1] *Annals of Commerce*, vol. iii., pp. 331, 332. *Cf.* also Philips' *History of Inland Navigation*, 4th ed., p. 88 *et seq.*

any kind in civil engineering when he was first consulted with respect to the canal from Worsley to Manchester projected by Francis Egerton, the third and last Duke of Bridgwater, who, if Brindley merits the first, should certainly be awarded the second place in the history of inland navigation. The Duke, who was born in 1736 and succeeded to the title when only twelve years of age, appears to have been scarcely less original in character than Brindley, whom he resembled in the combination of a rough exterior and homely manner with a kind heart and inflexible integrity—and it may be added in his love of tobacco. After his return from the "grand tour" he became the owner of racehorses, which he sometimes rode himself, and fell in love with and was accepted by the Duchess of Hamilton, one of the beautiful Miss Gunnings; and the idea of the famous canal which brought him into contact with Brindley would in all probability have never occurred to him had he not been driven to interest himself in the development of his estates by the unexpected termination of his engagement with the Duchess, on account of her refusal to discontinue relations with her sister, Lady Coventry, whose reputation had been assailed by the tongue of scandal. When he died unmarried in 1803, having survived Brindley by thirty-one years, he had expended £220,000 on his own canals, the revenue from which ultimately reached £80,000 per annum; and to the end of his life he took the greatest interest not only in his mines, canals, and mills, but in the welfare of the vast number of operatives whom he employed, building cottages for them, establishing Sunday schools, endeavouring to curb their in-

temperate habits, and—while, to quote Dr Smiles, "he did not lord it over them"—teaching them "above all things to help themselves."[1]

Though the development of inland navigation not only gave an immense impetus to manufactures but also to agriculture,[2] and though the Bridgwater Canal from the first awoke an extraordinary amount of public interest, it necessarily, like all new systems, had to contend with strong opposition at its inception. Canals would, it was said, ruin the trade of those employed in land transport, diminish the number of draught horses, and destroy great quantities of land that might be used for corn growing. It was maintained also that they would destroy the coasting trade, and thus weaken the navy; that the natural navigation of rivers was being neglected, through the undue attention given to canals; and that vast sums of money were being sunk in their construction.[3] Some of these objections were answered by a contemporary of the Duke of Bridgwater, Richard Whitworth, who, in 1766,

[1] *Cf.* Smiles' *Lives of the Engineers*, vol. i., pp. 308, 334, 345, 394, 397, 405, 415; and the *Dictionary of National Biography*, Arts. "Brindley" and "Francis Egerton."

[2] Cunningham's *Growth of English Industry*, vol. ii., p. 536.

[3] Whitworth's *Advantages of Inland Navigation*, p. 29; Macpherson's *Annals*, vol. iii., p. 332, vol. iv., p. 257. In a Paper on Inland Navigation and Public Roads contributed by the engineer William Jessop to Hunter's *Georgical Essays* published in 1804, the writer points out that "4 acres of land are cut up for the length of 1 mile of canal; but this land so cut up is not yet lost, but may become a pasture for fish, and equally valuable as in its former state; and one horse on a canal is capable of doing the work of fifty horses upon a road." He estimates the total length of the canals then contemplated at 1000 miles, the sea line of England, Scotland, Ireland, and the adjacent islands being about 3800. *Essay*, vol. ii., p. 78.

published a treatise, dedicated to Lord Gower, Lord Steyne, and Mr Pitt, entitled *The Advantages of Inland Navigation*, in which he advocated the connection by means of canals of "the three great Ports of Bristol, Liverpool, and Hull." He excuses the neglect of river navigations on the ground that they "are subject to floods at one part of the year, and at the other to shallows for want of water in a dry summer," and after eulogising Brindley and the Duke, maintains that "that sort of navigation is almost universally agreed to be laid aside," and that the land transport trade could be effectually protected from the injurious effects of competition with canals by an enactment of the State that no canal should be made nearer than four miles to any town or village. On the other hand, he urges the advantages which inland waterways would afford for the speedy transport of the heaviest ordnance and of troops to any part of the country in case of invasion or rebellion, citing as an illustration the difficulties experienced in this respect in "the inconsiderate [*sic*] rebellion in 1745," owing to the then condition of the high roads "even fourscore miles from the metropolis."[1] His proposed inland navigation was designed to run from Tern Bridge near the Severn in Shropshire, *viâ* Bridgeford and Stafford and Burton, joining the Trent at Wilden Ferry, while another arm was to run from Bridgeford *viâ* Madeley Park in Staffordshire to unite with the Weaver at Winsford Bridge in Cheshire, and thus on into the Mersey,[2] but the scheme seems never to have been

[1] P. 29.

[2] *Cf.* pp. 7-9. The intended route is illustrated by an excellent map and its feasibility by tables showing the estimated cost of

carried out. His views as a promoter of canals are shared by Macpherson, who points out, *inter alia*, that the development of inland navigation instead of injuring, as was prophesied, had enormously benefited the coasting trade and the navy, since, between 1760, the year preceding the opening of the Bridgwater Canal, and 1790, when the whole country was intersected with artificial waterways, the tonnage of ships clearing out of English ports rose from 471,241 tons to 1,379,329 tons.[1]

Whitworth's project for uniting the three ports of Liverpool, Hull, and Bristol already alluded to was carried out eventually on other lines by the Grand Trunk Canal, constructed by Brindley, the first sod of which was cut on 26th July 1766 but which was not finished until 1777 owing to the enormous labour of cutting the Harecastle Tunnel, which occupied some eleven years, and was not completed till after the great engineer's death. At the instance of Lord Gower, Brindley had already

the undertaking, the manufactures, amount of trade, and the names and extent of property of landowners at the various places on the proposed waterways. Whitworth also took the trouble to draft the petition to be presented to Parliament and some resolutions to be submitted to public meetings to be held at Bristol, Liverpool, Hull, and Stafford in favour of the project, pp. 15-24.

[1] *Annals of Commerce*, vol. iii., pp. 332-35. The eighteenth century produced various other publications similar to that of Whitworth, such as :—"A view of the advantages of inland navigation, with a plan of a navigable *canal* intended for a communication between the ports of Liverpool and Hull," by an anonymous writer, published in 1765; "A cursory view of the advantages of an intended *canal* from Chesterfield to Gainsborough," published in 1769; and, "Extracts from Mr Young's six months' tour through the North of England, and from the letter of an unknown author, published in the *London Magazine* of October 1772 on the subject of canal navigations, addressed to the Lord Mayor, Aldermen, and Common Council of the City of London, by James Sharp, 1777."

made a survey of a portion of this canal before his engagement as engineer for the Bridgwater undertaking. The project, however, made little progress, and, after the completion of the Duke's Canal, was rendered more difficult by the number of competing schemes brought forward in Cheshire after the success of the latter work; and even after Smeaton (who was called in to co-operate with him) and Brindley had made a joint survey and report, several years elapsed before any action was taken. One of the prime movers in promoting the canal was Brindley's friend Josiah Wedgwood, who from the first perceived its advantages to the potteries district, cut the first sod at the inaugural ceremony, and eventually removed his works from Burslem to Shelton, situated on its banks, between 1769-71, where he erected the finest manufactory of the kind then in existence in England, and built a house for himself and cottages for his work people. The Bill for its establishment encountered an enormous amount of opposition both in and out of Parliament, which originated chiefly amongst the gentry of Cheshire, who protested against it as calculated to place the monopoly of the Staffordshire and Cheshire traffic in the hands of the Duke of Bridgwater, and promoted other schemes which would have placed a similar monopoly in the hands of the Weaver Navigation Company.[1] These were, however, rejected by Parliament, and the Grand Trunk Canal Act became law, while another important Act was at the same time passed empowering the construction of the Wolverhampton Canal, now known as the

[1] The first Act for making the Weaver navigable was obtained in 1721.

Stafford and Worcester, from the Severn near Stourport to the Trent at Great Heywood, thus completing the union of the Mersey, Humber, and Severn.[1] "The Grand Trunk," says Smiles, "was the most formidable undertaking of the kind that had yet been attempted in England. Its whole length, including the junctions with the Birmingham Canal and the river Severn, was 139½ miles. In conformity with Brindley's practice he laid out as much of the navigation as possible upon a level, concentrating the locks in this case at the summit near Harecastle, from which point the waters fell in both directions, north and south. Brindley's liking for long flat reaches of dead water made him keep clear of rivers as much as possible. He likened water in a river flowing down a declivity to a 'furious giant' running along and overturning everything; 'whereas,' said he, 'if you lay the giant flat upon his back he loses all his force, and becomes completely passive whatever his size may be.' Hence he contrived that from Middlewick, a distance of 17 miles, to the Duke's Canal at Preston Brook, there should not be a lock; but goods might be conveyed from the centre of Cheshire to Manchester, for a distance of about 70 miles, along the same uniform level. He carried out the same practice, in like manner, on the Trent side of Harecastle, where he laid out the canal in as many long lengths of dead water as possible."[2] The five tunnels on the canal—of which the Harecastle was 2880 yards, the Hermitage 130 yards, the Barnton 560 yards, the Saltenford 350 yards, and the

[1] Smiles' *Lives of the Engineers*, vol. i., pp. 424, 431, 432, 439, 440.
[2] *Ibid.*, p. 440.

Preston-on-the-Hill 1241 yards long—were the most formidable works in its construction, the most extensive ridge penetrated being at Harecastle—a continuation of high ground known as the *backbone* of England, extending from the Yorkshire mountains in a south westerly direction to the Wrekin.[1]

In addition to the canals above-mentioned, Brindley laid out the Coventry Canal to Oxford, connecting the Grand Trunk System by Lichfield with London and the navigation of the Thames; the Birmingham Canal, which brought the advantages of inland navigation to the central manufacturing districts; the Droitwich Canal, connecting that town with the Severn; and a canal 82 miles long from Oxford to the Coventry Canal. The Acts authorising the first three of these canals were passed in 1768, and that obtained for the Coventry Canal in 1769; and though of these the works of the Droitwich Canal were the only ones wholly executed by Brindley, who died before the completion of the Birmingham Canal, the other schemes were carried out by his successors — Whitworth, Smeaton, Rennie, and Telford—under Acts based on, though not all strictly after his plans, which thus laid the foundation of the Midland Canal System.[2] Another of Brindley's canals, the Chesterfield, between that place and the Trent at Stockwith, 46 miles in length, intended for the transport of coal, lime, and lead from Derbyshire,

[1] *Lives of the Engineers*, vol. i., p. 440. The Harecastle Tunnel was reconstructed by Telford on a larger scale which did away with the necessity for the tedious and exhausting process of *legging* boats through it, to accomplish which the *leggers* had to lie on the deck of the vessel and push it along by pressing their feet against the sides of the tunnel.

[2] *Ibid.*, pp. 449, 452.

though authorised in 1769, was finished by his brother-in-law Mr Henshall, and not opened until several years after the demise of the latter.[1] Besides these works constructed or planned by himself, Brindley was consulted as to the Leeds and Liverpool Canal, the Aire and Calder navigation, the Forth and Clyde Canal, the Salisbury and Southampton Canal, the Lancaster Canal, and the improvement of the Thames navigation to Reading.[2] Many of his successors in canal construction were men of singular boldness of conception, and of the highest professional attainments:—such as Smeaton (1724-1792), who was employed in the construction of the Forth and Clyde Canal in Scotland, and was also consulted with regard to the improvement of the Birmingham Canal, the Grand Canal in Ireland, and other similar

[1] *Lives of the Engineers*, vol. i., p. 453. Dr Smiles gives the following list of the canals laid out and principally executed by Brindley:—

		M.	F.	Ch.
The Duke's Canals	Worsley to Manchester	10	2	0
	Longford Bridge to the Mersey below Runcorn	24	1	7
Grand Trunk Proper from Wilden Ferry to Preston Brook		88	7	9
Wolverhampton Canal		46	4	0
Coventry Canal		36	7	8
Birmingham Canal		24	2	0
Droitwich Canal		5	4	9
Oxford Canal		82	7	3
Chesterfield Canal		46	0	0

He quotes from a Memoir of Brindley by Samuel Hughes, C.E., an important fact to be remembered in estimating the former's difficulties, viz.:—"The entire absence of experience in former works, the obscure position which the engineer occupied in the scale of society, the imperfect communication between the profession in this country and the engineers and works of other countries, and lastly, the backward condition of all the mechanical arts, and of the physical sciences connected with engineering." *Ibid.*, p. 454.

[2] *Ibid.*, p. 458.

schemes.[1] Rennie, (1761-1821) constructed the Kennet and Avon Canal, the Rochdale Canal, the Lancaster Canal, a new branch of the Grand Trunk, and in 1802 conducted an examination of the Grand Canal of Ireland. Telford (1757-1834) was the constructor of the Ellesmere canals—a series of navigations proceeding from the Dee in the vale of Llangollen, one of which runs, in a northerly direction, near Ellesmere, Whitchurch, Nantwich, and Chester to Ellesmere Port on the Mersey; another south-east through the centre of Shropshire to Shrewsbury on the Severn; and a third south-west *viâ* Welshpool to Newtown.[2] In 1795 he was appointed engineer to the Shrewsbury Canal, and he also engineered the Caledonian, and the Glasgow and Ardrossan Canals in Scotland, the Gloucester and Berkeley Canal, the Birmingham and Liverpool Junction, and the Macclesfield canals in England, and improved the Grand Trunk (rebuilding the Harecastle Tunnel), and the Birmingham canals.[3]

It was not until 1794 that the first Welsh canal—the Glamorganshire or Cardiff, which is 25 miles long and runs from Merthyr Tydfill to the Taff River near its entrance in Penrith Harbour, and which was begun, under the 30 Geo. III. c. 82, in 1790—was opened.[4] This was

[1] *Lives of the Engineers*, vol. ii., pp. 57, 82.

[2] This series of waterways is at present known as the Shropshire Union Canal. *Cf.* Philips' *History of Inland Navigation*, 4th ed., pp. 297, 385, 390, 465, 479; Macpherson's *Annals of Commerce*, vol. iv., p. 282.

[3] *Lives of the Engineers*, vol. ii., pp. 340, 346, 404, 418, 425. Telford also prepared the plans for the Gotha Canal in Sweden.

[4] Priestley's *History of Inland Navigation*, pp. 301-3. The Act of 1790 was followed by 36 Geo. III. c. 69, passed in 1796, *cf.* Jeans' *Waterways and Water Transport*, p. 52.

followed by the Neath Canal, 14 miles in length, between Abernant and Neath, constructed between 1791 and 1798;[1] and the Aberdare Canal connecting the town of that name with the Glamorganshire Canal, and traversing in its short course of 6½ miles an important mining and manufacturing district, the construction of which was sanctioned by 33 Geo. III. passed in 1795.[2] The only other canal of importance is the Swansea 19 miles in length which connects Swansea Harbour with various copper and other works beyond that point and Penstawe, and which was begun under 34 Geo. III. c. 109 in 1794 and completed four years later.[3] The Glamorganshire Canal, at the terminus of which in the Taff River there is a sea lock with a floating dock accommodating vessels of considerable tonnage, and the Aberdare Canal were transferred to the Bute Dock Company in 1885.[4]

The majority of the above-mentioned canals are *arterial* canals connecting river basins, or bringing towns in their neighbourhood into connection with them; but one of them, the Gloucester and Berkeley Canal, is distinguished from the others in being both a *lateral* canal—*i.e.*, one constructed alongside a river to avoid insurmountable obstacles, such as a waterfall or rapids, or a shallow shifting bed, or a torrential flow of water—and also a ship canal, or a waterway constructed to provide deep water access to the sea for old ports, or to convert inland towns,

[1] Jeans, p. 52; Priestley, pp. 493-96. The Acts relating to this canal are 31 Geo. III. c. 85, and 36 Geo. III. c. 30.

[2] *Ibid.*, p. 52; Priestley, pp. 1-2.

[3] *Ibid.*, p. 52; Priestley, p. 648.

[4] *Ibid.*, p. 52.

such as Exeter, Gloucester, and Manchester into sea-ports.[1]

The oldest ship canal in the kingdom is, as already stated,[2] that constructed in 1544 from Topsham to Exeter, which previous to 1820 was only available for vessels of a draft not exceeding 9 feet, but owing to improvements carried out by Mr J. Green under the advice of Telford, now enables vessels drawing 14 feet of water to pass up to a basin and wharves at Exeter, and is still useful for the coasting trade in coal and timber, though increase in the number of steamers has diminished its importance.[3]

The original Act for constructing a ship canal from Gloucester to the estuary of the Severn at Sharpness in the parish of Berkeley was obtained in 1793,[4] but, in spite of further powers conferred on the company by a second Act in 1794, want of funds prevented the commencement of the project till 1818, when an advance of £160,000 was obtained from the Exchequer Loan Bill Commissioners, and Telford's services were secured as engineer. A canal 16½ miles in length with a width of 80 to 100 feet at the water level and 13 to 20 feet at the bottom was completed by Telford in 1827 at the cost of £500,000, thus providing a direct and still water navigation to Gloucester in lieu of the 26 miles of circuitous route by the river, the tidal currents in which are very rapid. Access to

[1] *Rivers and Canals*, vol. ii., pp. 351, 550, 560, 580. *Cf.*, as to ship canals, *The Principles and Practice of Canal and River Engineering*, by David Stevenson, M.Inst.C.E., 2nd ed., p. 27 *et seq.*

[2] See *ante*, pp. 51-2, 95-6.

[3] Cf. *Encyclopædia Britannica*, ed. 1902, Art. "Canal," by Sir E. Leader Williams.

[4] 33 Geo. III. c. 97.

the canal from the estuary has now been improved by the construction of a tidal basin with an entrance into the estuary a little lower down, having a width of 60 feet, and a depth of 16 feet over the sills at neaps, and of 29 feet at spring tides, and with a lock leading to the canal 320 feet long and 60 feet wide. The lock at Gloucester has also been deepened so as to admit vessels drawing 9½ instead of 7½ feet as formerly, and vessels of about 600 tons can now navigate the canal up to the city, which is the most inland port in the kingdom, while vessels of 300 tons can pass up the Severn to Worcester.[1]

The Manchester Ship Canal is interesting, not only because its opening has been the most important event in the modern history of the district and because its construction is one of the most notable feats of modern engineering, but also because it may in one sense be regarded as a nineteenth-century development of the Bridgwater Canal, for the purchase of which £1,786,313 was paid by the company, and which has thus now become part of the system of the ship canal. A proposal to form a canal from Manchester across Cheshire to the estuary of the Dee was made early in the nineteenth century with the view of avoiding the payment of the high Liverpool dock dues and heavy railway rates to which the larger population and more important manufacturing community of Manchester were subjected, and the Manchester Chamber of Commerce urged the construction of a ship canal from the city to the sea in 1877.

[1] *Cf.* Philips' *History of Inland Navigation*, pp. 392, 403; *Rivers and Canals*, vol. ii., pp. 551-52; and *Lives of the Engineers*, vol. ii., p. 421.

Though, however, two schemes were submitted to the promoters in 1882, it was not till 1885 that any definite action was taken in the matter, and the canal was not opened for traffic till January 1894, the official opening ceremony being performed by Queen Victoria on 21st May of that year. One of the greatest obstacles to the construction of the canal has been the large expenditure necessary on account of the numerous bodies possessing vested interests in the route it traverses, and out of the total expenditure of £15,173,402 on capital account, including £1,786,313 paid as above stated for the Bridgwater Canal, £1,214,451 was paid for land and compensation to various authorities. No less than 53,000,000 cubic yards were excavated for the former canal, ninety-seven excavators, eight large bucket-ladder dredgers, and some small dredgers being employed on the work, in addition to the fifty-eight steam navvies by which the main portion of it was accomplished. The 35½ miles of the canal consist of three sections—from Eastham to Runcorn, where it runs near or through the Mersey Estuary, a distance of 12¾ miles; from Runcorn to Latchford near Warrington, 8½ miles, where it is inland, but in which the level of the water, as in the first section, is raised by the tides; and from Latchford, where the locks stop the tidal action, the canal being fed by the Mersey and Irwell, up to Manchester, a distance of 14½ miles. The three tidal locks at Eastham have chambers 600 feet by 80 feet, 350 feet by 50 feet, and 150 feet by 30 feet, with sills 28 feet, 25 feet, and 16 feet respectively, below the normal water level of the canal; and it may be added that, as pointed out

by Mr Vernon Harcourt, the Manchester Ship Canal is the first large ship canal which has been constructed with locks raising vessels 60½ feet and transporting them inland, and thus converting an inland city into a sea-port.[1] The most notable feature of the work is, perhaps, the swing aqueduct for the Bridgwater Canal—the first of its kind—which was constructed by Sir E. Leader Williams to replace that built by Brindley 136 years previously, which was the first *fixed* navigable aqueduct constructed in England—by means of which, when closed, traffic can pass along the Bridgwater Canal as heretofore, but which can be opened to allow of ships crossing it on the lower level of the ship canal.[2]

[1] Cf. *Rivers and Canals*, vol. ii., p. 592.

[2] *Ibid.*, pp. 580-93; and *Encyclopædia Britannica*, ed. 1902, Art. "Canals — Ship Canals," by Sir E. Leader Williams, and Art. "Manchester Ship Canal," by W. E. A. Axon, LL.D. The total traffic on the canal increased from 925,659 tons in 1894 to 2,942,393 tons in 1901, the sea-borne traffic having risen from 686,158 tons in the former to 2,684,833 tons in the latter year, while the barge traffic, after increasing from 239,501 tons in 1894 to 377,580 tons in 1898, fell to 257,560 in 1901.

CHAPTER VIII

THE CANAL ERA IN ENGLAND AND WALES—*continued*

The Kennet and Avon Canal. The Thames and Severn Canal described by a contemporary. Great increase of water traffic due to canal construction. Zachary Allnutt. System of waterways west of London. Time tables, fares, and rates. Passenger traffic. Conveyance of troops by canal. Value of canal system as means of intercommunication. Revolution in trade. Rapid progress of the movement. The canal "mania." Extent of inland navigation system in 1838-39. "Brindley the conqueror of Napoleon."

It may be noted with respect to two of the canals mentioned in the last chapter, that the connection of Droitwich with the Severn carried out by Brindley had been projected by Yarranton,[1] who proposed to accomplish it by improving the navigation of the Stour, and that the still earlier suggestion of Francis Matthew for improving the navigation of the Avon and connecting it with the Thames was realised by the construction of the Kennet and Avon Canal. The latter navigation, first surveyed by Rennie in 1793 but not completed till 1810, was pronounced to be one of the best executed in the kingdom. It is 57 miles in length and runs from

[1] *Lives of the Engineers*, vol. ii., pp. 140, 151.

the head of the Kennet *viâ* Newbury and Hungerford, the vale of Pewsey, Devizes, and Bradford, to Bath where it joins the Avon and is continued to Bristol, thus connecting the navigation of London with that of Bristol and St George's Channel. Its most notable feature is the aqueduct over the Avon at Limpley Stoke, and the Kennet is also crossed several times—at Hungerford by a brick aqueduct of three arches.[1]

The Thames and Severn Canal was the realisation of a much mooted project among London and Bristol merchants in the reign of Charles II., when a Bill on the subject was introduced into Parliament and a survey of the ground was made by Joseph Moxon hydrographer to the king. Though, as was the case with numerous other schemes of the kind ventilated during the period, no practical results ensued, the idea still continued to be discussed in mercantile circles, and formed the subject of a characteristically poetical letter written by Pope in 1722 to Mr Digby while on a visit to Lord Bathurst at Cirencester. "I could pass," he says, "whole days in only describing the future and as yet visionary beauties that are to rise in these scenes; the palace that is to be built, the pavilions that are to glitter, the colonnades that are to adorn them; nay more, the meeting of the Thames and Severn which, when the noble owner has finer dreams than ordinary, are to be led into each other's embraces through secret caverns of not above 12 to 15 miles, till they rise and celebrate their marriage in the midst of an immense amphitheatre,

[1] *Cf.* Priestley's *History of Inland Navigation*, pp. 52-54; *Annals of Commerce*, vol. iv., p. 300.

which is to be the admiration of posterity a hundred years hence."

The following interesting account of the construction and opening of the canal by which the union of the "fair Sabrina" with the "lordly Thames" was eventually effected, is given by a writer who may possibly have been himself a witness of the scene he describes.

"In 1775 a canal was formed by Act of Parliament from Framlode on the Severn to Wallbridge near Stroud, and called the Stroudwater Canal, a distance of rather more than 8 miles, in which space there is a fall of 802 feet. By Acts of the 22nd, 31st, and 36th of Geo. III. leave was granted to put into execution the important plan of bringing the Stroud Canal into junction with the Isis and the Thames. In 1782 several opulent individuals in London, chiefly merchants, engaged the able and intelligent engineer Mr Robert Whitworth to make a draught and estimate of the expenses, and in 1783, when the Act was finally obtained, it was expected that the sum of £130,000 would be sufficient to complete the work, but that, in case of emergency, the sum of £60,000 was to be raised on mortgage. The citizens of the metropolis, sanguine in the success of the enterprise, subscribed the requisite amount; and so zealous were many in the cause that the connexions of one mercantile house alone contributed £23,000, and others £10,000. In less than seven years the canal was completed, and on the 19th November 1789 the first vessel passed from the Severn into the Thames.[1] . . . A communication thus

[1] *Cf.* Humpherus' *History of the Watermen's and Lightermen's Company*, vol. ii., p. 380.

opened with Wales, Bristol, Gloucester, and Shrewsbury, bringing into connection the canals of Staffordshire, Shropshire, Warwickshire, and Oxfordshire, offered sufficient grounds on which a lucrative return for the original outlay might have been reasonably calculated; but we fear these anticipations have not latterly (*circ.* 1835) been realised, as the amount of the dividend has now become extremely limited. The formation both of this and the Stroudwater Canal met with numerous obstacles prior to their completion, as well from interested parties as from natural causes. The water in its course from Stroud through the beautiful and luxuriant vale of Chalford to Sapperton, or Salperton, a distance of 7 miles 3 furlongs, is raised, by means of twenty locks, 241 feet 3 inches. At Sapperton, the country becoming hilly, a subterranean channel or tunnel was cut through Sapperton Hill extending 4300 yards, or about $2\frac{3}{7}$ miles; in making the excavation the hill was found to consist chiefly of stone, and considerable time and expense was incurred in blasting it. The passage was eventually effected by Mr Clowes the acting engineer on 20th April 1789. The tunnel is 15 feet in breadth, and 250 feet below the highest portion of the hill; with an arch of masonry at the top and an inverted arch at the bottom, except where the rock rendered it unnecessary. The cost was about eight guineas the cubic foot. From hence the canal pursues a devious course through Gloucestershire and Wiltshire to Inglesham, near Lechlade, a distance of 20 miles 3 furlongs, during which the water falls 130 feet 6 inches, and is upheld by fourteen locks. The greatest width of the canal at top is 42 feet, 30 feet

at the bottom, and 5 feet in depth. The banks and towing paths are made from the soil dug out of the canal, having warehouses, with cranes placed at convenient distances. A branch connects the navigation with the city of Cirencester. The barges are generally 12 feet broad, 8 feet long, and draw when freighted about 4 feet of water; their burthen being about 70 tons. The whole length of the canal is 30 miles and 7½ chains, which, added to the length of the Stroudwater, makes the distance from the Severn to the Isis about 39 miles." [1]

In former times the Thames and Severn Canal —the small trade on which beyond Brinscombe was, until ten years ago, carried on in what are termed "monkey" boats of about 30 tons burthen—was frequented by 70 ton barges drawing about 4 feet of water, which carried coal, corn, timber, and other commodities between Gloucester and the Severn Ports and Oxford, Reading, and London; and during the French war a vessel of 150 tons is said to have been navigated through the canals and river from Gloucester to the metropolis.[2] Like that of a large majority of canals its prosperity began to decline on the introduction of railways, and the Great Western Railway acquired nearly four-fifths of the shares; but in 1895 it was taken over by the Thames and Severn Canal Trust, a body on which all the waterways connected with it, as well as the counties which it traverses, are represented.[3] The

[1] Tombleson's *Thames*, pp. 9 and 10, and cf. *Annals of Commerce*, vol. iv., p. 194.

[2] *Cf.* Taunt's *New Map of the River Thames from Thames Head to London*, 3rd. ed., p. 151.

[3] De Salis's *Chronology of Inland Navigation in Great Britain*, p. 115. The Trust consists of representatives of the Sharpness New

extent of the traffic which sprang up on our waterways after their connection with each other by canals may, to some extent, be surmised from a small book, which may be termed an embryo *Water Bradshaw* compiled by Zachary Allnutt, a superintendent and receiver on the Thames navigation. This work, entitled *Useful and Correct Accounts of the Navigation of the Rivers and Canals West of London*, gives particulars with respect to the distances, times occupied in navigation, and rates of carriage on the Thames, Wey, and Severn Rivers, and on the Kennet and Avon, Basingstoke, Wilts and Berks, Stroud, and Berkeley Canals; and, as it appears to have passed through three or four editions, and to have been sold by four different booksellers in London, may be presumed to have been in demand amongst canal shareholders, traders, and manufacturers at the time of its publication in 1810. From this we learn that the speed of barges on the Thames was from 25 to 35 miles per day downwards and 20 to 30 miles per day upwards, the average passage of the 146 miles from Lechlade to London, being thus between five and six days. The time occupied in navigating the 50 miles between London and "Gottalmin" [*sic*] on the Wey was three or four days, while it took a whole day to traverse the 8 miles of the Stroud Canal owing to the number of locks and the absence of horse-towing paths. The routes described are

Dock Bristol and Gloucester and Birmingham Navigation Co., the Stroudwater Navigation, the Staffordshire and Worcestershire Canal Co., the Wilts and Berks Canal Co., the Severn Commissioners, the County Councils of Berks, Gloucester, and Wilts, the Town Council of Gloucester, and the Urban District Councils of Stroud and Cirencester.

those from London to Liverpool and Manchester, to Bath and Bristol, to South Wales, to Oxford, and to Gloucester; and from Bristol and Bath to Oxford, to Birmingham, and to Coventry. The information as to the Grand Junction and Oxford Canals is limited to prices of carriage, but full particulars are given respecting the Hereford, Monmouth, Glamorganshire, Neath and Swansea Canals, the river Wye, and the Dean Forest and Sirhowey railroads just coming into use for the transport of minerals. The average prices of carriage, which it will be noted are lower on rivers than on canals, may be seen from the following table:—

	Valuable goods, perishable or liable to risk, a ton per mile.	Other goods, coarse or heavy, a ton per mile
The average price of carriage, including tolls, etc., by the Basingstoke, Kennet and Avon, Wilts and Berks, Thames and Severn, and Stroud Canals, is .	5d. to 5¾d.	3¼d. to 4d.
The average price of carriage by other canals, viz., Grand Junction, Oxford, Birmingham, Stafford and Worcester, and Grand Trunk, is	5½d. to 6d.	3¾d. to 4¼d.
The average price of carriage, including tolls, etc., on the rivers Thames and Isis, Wey, Kennet, Avon, and Severn, is	2½d. to 3d.	2d. to 2½d.
The average price of carriage on the river Mersey, Runcorn to Liverpool, is	3d. to 3½d.	1¾d. to 2¼d.
The average price of carriage by the Trent, Gainsborough to Shardlow, is	2¾d. to 3¼d.	2d. to 2½d.
The average price of carriage by the Severn, Stourport to Bristol, is . .	2½d. to 3d.	2d. to 2¼d.

The traffic on canals, however, was originally not solely limited to goods. In some cases these

were used for the conveyance of passengers. Macpherson tells us in his *Annals of Commerce*,[1] that the Duke of Bridgwater in 1772 established regular passage boats for carrying, at first about sixty, and afterwards from eighty to one hundred and twenty passengers, with a reasonable amount of luggage, for "about 20 miles as quickly as they could travel by land for 1s. apiece," the larger boats having accommodation for three different classes of passengers at rates of 1s., 1s. 6d., and 2s. 6d., and being "each provided with a coffee-house kept by the master, wherein his wife serves the company with wines and other refreshments." Similar boats were also, as will be seen later on, employed on the Grand Canal in Ireland; and the announcement in the *Times* of 19th Dec. 1806 of the despatch of troops from London to Liverpool *en route* for Ireland *viâ* the Paddington Canal seems to justify the conclusion that there must also have been some passenger traffic on waterways. The length of time occupied in such journeys may be gathered from the fact that it is pointed out in the above-mentioned notice in the *Times* that the troops would be enabled by this mode of transport to reach Liverpool *in only seven days*, as relays of fresh horses for the boats had been ordered to be in readiness at all the stations.[2]

The satisfaction thus expressed that a journey of

[1] Vol. iii., p. 527 note.

[2] Cf. *Lives of the Engineers*, vol. i., p. 465 note. In Ireland these fast passenger boats appear to have been termed "fly" boats—a term originally derived from Dutch vessels so called which were large and flat-bottomed with a very high stem resembling a Gothic turret and very broad buttocks, and were generally of from 300 to 600 tons burthen. See Smyth's *Sailor's Word Book*, p. 310. *Cf.* chap. x., p. 190, *post.*

200 miles could be accomplished in a week, ludicrous as it seems in these days of mono-railways and record express runs, was natural enough at the time when, owing to the state of the roads, the inhabitants of London were, as Macaulay says, practically further from Reading than they now are from Edinburgh, and when a viceroy proceeding to Ireland had been known to spend five hours in travelling 14 miles.[1] Brindley and the Duke of Bridgwater may be said to have provided their country with the best and most extensive system of intercommunication which it had possessed since it ceased to be a Roman province, the establishment of which effected a revolution in trade and in our national prosperity, the extent of which is difficult now to realise, but which was certainly equal to—if it did not, indeed, on account of its novelty surpass—that resulting from the introduction of the railway system which superseded it. The numerous projects for its advancement which followed each other with almost startling rapidity were eagerly taken up, and the capital readily subscribed by the public, who were not slow to perceive the soundness of the investments guaranteed, as to their prospective returns and constructive possibilities, by engineering experts such as Brindley and Telford, Smeaton and Watt, Nimmo and Rennie. In a very few years after Brindley's death in 1772 an immense number of navigation Acts received the sanction of Parliament, and canals began to be freely quoted "on change." By 1782 the progress of the movement for the carriage of goods by canal—evidenced by the construction of the Northampton, the Stafford and Worcester, the Trent

[1] *History of England*, vol. i., pp. 373, 376.

and Mersey, the Leeds and Liverpool, and the Birmingham canals—had, though somewhat retarded by the war of American Independence, sufficiently developed to form part of a scheme by Lord North in that year, which was, however, not carried out, for the taxation of goods carried by river or canal.[1] Between 1789-92 as many as thirty navigation Acts were passed, eighteen of which were notified in the *Gazette* for August of the last-named year. In the year 1790 what Mr Lloyd has aptly named the "canal mania"[2] began, and the premiums of single shares in companies had already reached such figures as £155 (Leicester), £350 (Grand Trunk and Coventry), and £1170 (Birmingham). In the four years ending 1794 eighty-one canal and navigation Acts were obtained, of which forty-five were passed in the latter two years, authorising an expenditure of over £5,000,000. Forty-one more Acts were passed between 1794-96, and among the taxes proposed by Pitt in 1796 to meet the strain on the national resources caused by the war was one on inland navigations estimated to produce £120,000 per annum, a project which, like that of Lord North, was eventually abandoned owing to the objections raised to imposing a tax on a special class of property, and so checking the development of a new form of transport.[3] Up to the close of the year

[1] Dowell's *History of Taxation*, 2nd ed., vol. iii., pp. 54-67.

[2] *Cf.* a Paper by Mr Lloyd read before the British Association at Birmingham in 1887.

[3] Dowell's *History of Taxation*, vol. iii., pp. 54-57. Some idea of the amount of traffic upon canals in the days of their prosperity may be gathered from particulars given with respect to the principal descriptions of goods carried on them contained in *Inland Navigation; or Select Plans of the Several Navigable Canals throughout Great Britain*, by John Cary, published in 1795. The principal articles

1838-39 there had, according to a calculation made by Rennie, been formed in Great Britain 2236 miles of improved river navigation at a cost of £6,269,000, and 2477 miles of canals at a cost of £24,406,389.

As was to be expected, and in striking analogy with what subsequently occurred at the introduction of railways between the years 1840-46, the close of the eighteenth century witnessed a great deal of more or less reckless speculation, and the promotion of schemes which were financially unsound in themselves, and which had no solid basis of remunerative profit to recommend them. But the commercial success which followed the opening of the Bridgwater, and shortly after it of the Grand Trunk Canal, and the high dividends paid by all the first companies, made it easy to get shares in all really sound concerns, and these the public readily subscribed for, four times the amount required for the Ellesmere canals, which passed through a difficult country involving costly works, being, for instance, taken up without hesitation. "By the year 1792," says Dr Smiles, "the whole country was in a perfect ferment about canal shares," and as late as 1818 we find Grand Trunk shares which yielded a dividend of £65 quoted at £1530 per share.[1]

carried on the Grand Junction, he tells us, were coal and the manufactures of Lancashire; pottery wares from Staffordshire and glass wares from Stourbridge and Dudley, etc.; hardware from Birmingham, Wolverhampton and Walsall, etc.; and cheese, salt, grain, lime, hay, straw, limestone, building stone, timber, ale and cyder, and hops from Worcestershire. From London the chief articles of traffic were tin, raw materials for Manchester manufacturers, grain, coals, flint, breeze ashes, dung and other forms of manure, etc., p. 119.

[1] *Lives of the Engineers*, vol. i., p. 462. Cf. *The Gentleman's Magazine* during this period, and vol. lxxiv. for 1818, pp. 87, 153, 279, 375, 471, 561.

It is related by Mr Wells [1] that in discussing the great advance made by England in manufactures towards the latter half of the eighteenth century with an American engineer at one of the late International Congresses, the latter went so far as to say that it was James Brindley who really conquered the Emperor Napoleon. "It was largely," he averred, "due to the cheapening of transport by Brindley's canals that England prospered as a manufacturing country, became wealthy and able to provide the sinews of war, not only for arming and equipping her own soldiers and sailors, but for subsidising European nations to fight against the common enemy," and though Mr Wells himself considers this to partake of the nature of hyperbole, he agrees that our debt to Brindley is very great, and that we cannot acknowledge it more suitably than by resuscitating the traffic that has been lost, and adding to the amount of traffic on inland waterways, for the benefit of our generation and those who come after us.[2]

[1] *Cf.* a Paper read by Mr Lionel B. Wells at the Birmingham Conference of the Institution of Mining Engineers on Inland Navigation, 12th February 1895.

[2] A very complete account of all the British canals will be found in Priestley's *History of Inland Navigation*, and also in Rees' *Cyclopædia*, Art. "Canal," and in Brewster's *Edinburgh Enclycopædia*, Art. "Inland Navigation," and excellent maps illustrate the accounts of the two first-named authorities. For a more recent description, *cf.* Jeans' *Waterways and Water Transport*, p. 40 *et seq.*

CHAPTER IX

THE CONSERVANCY OF RIVERS IN ENGLAND AND WALES SINCE THE EIGHTEENTH CENTURY

Defects in old methods. Towing paths, mills, and "stanches." The first lock on the Thames. Brindley's project for canalising it. His contempt for rivers. Rivers the bases of canal system. Revival of interest in river improvement. William Jessop. Hindrance to navigation of rivers arising from natural flow and tidal action. Rapidity of stream and underlying geological strata as factors. River outlets. The tidal wave. Bars. Silting up of rivers. Objects of river conservancy. Training works for removal of shoals and protection of banks. Canalisation of rivers. The old lock and the new. Illustrations of training works. The Witham, the Welland, the Ouse, the Nen, the Dee, and the Ribble. Improved methods of dredging. The Tees, the Usk, the Wear, the Tyne, the Mersey. Illustrations of canalisation. The Severn and its conservancy. The river consists of four distinct sections. The "bore." Early legislation for improvement of the Thames. Jessop's report. Prejudicial effect of mills and fishing weirs on navigation. Improvements effected by the Upper River Commissioners in 1750. Neglect of the Lower River by the Corporation of London. Petition of barge masters and navigators, and its results. The river "below bridge." Boundaries of the Port of London. Extensive embankments against overflow. Great natural advantages of the river. Report of the Royal Commission of 1902. Decay of Upper River on decline of canal traffic. Transfer of powers of Upper River Commissioners to the Thames Conservancy Board in 1857. Constitution of the Board. Great improvements effected by it. Impediments to administration due to conflict of authorities. Its reconstitution in 1894. Its representative character. Rights and duties of the conservators. The Company of Watermen and Lightermen. The Trinity House.

THOUGH the development of the canal system was largely due to the fact that it originated, like the

great commercial companies which preceded, and the railway companies which followed it, in private enterprise, its progress during its earlier stages was, as has already been stated, materially furthered by the inadequate facilities for navigation both on the great rivers and on those which had been made navigable by Acts of Parliament.[1] The extent and the condition of towing paths were dependent on the riparian owners whose lands they traversed, who, while entitled to demand such tolls as they pleased for their use, regarded them as paid simply for the right of passage through their property. The navigation, even on great rivers like the Thames, was hampered by the numerous mills then still in existence, and it was a common complaint among owners of barges that the millers did not keep a sufficient head of water for their passage. The usual mode of providing for the navigation of shallows was by the erection across the narrow parts of rivers of *stanches*—weirs constructed of spars, planks, or paddles, supported by the pressure of the water against a sill below and by a movable beam above—which when closed deepened the river for a considerable distance behind them, and when opened by a man standing on a footbridge above, set free a sufficient volume of the water thus pent back to float boats over the obstruction.[2] It was not, as already mentioned,[3] until 1805 that the idea was first entertained of erecting locks on the Thames—the first lock at Teddington was not

[1] *Cf.* chap. vii., pp. 107-9.

[2] Cf. *Rivers and Canals*, vol. i., p. 64; and a description of stanches given by Mr Cubitt, *Proceedings of Institute Civil Engineers*, vol. iv., pp. 111, 112.

[3] *Cf.* chap. vii., *ante* p. 109.

opened till 1811—in lieu of *stanches*, which are apparently identical with what Matthew in one of his tracts calls *sasses*,[1] and they are still used on the Upper River above Oxford for maintaining the water level in summer, and were in existence on the Severn down to 1842.

These defects in the old methods of conservancy seemed to justify enthusiasts for canals, like Whitworth, in speaking of natural waterways as "obsolete." Brindley, who was employed by the Corporation of London in 1770 to survey the Thames with the view of improving the navigation above Battersea, suggested, as he almost invariably did in such cases, that this should be effected by means of a canal—a project which happily for lovers of the picturesque was abandoned on the construction of the Grand Junction Canal;[2] and when his fame was at its height his *dictum* that "rivers were made to feed canals" seemed destined to be universally accepted. This theory, however, ignored the facts that schemes such as that of Whitworth's for uniting Hull, Liverpool, and Bristol could only be carried out by uniting the rivers on which they were situated and from which they derived their importance as ports, and that, though canals might possess superior advantages for this purpose, it would have been absurd not to utilise such river navigations as were already available as links in the main through routes. In point of fact, the great rivers formed

[1] Cf. *The Opening of Rivers to Navigation.* Admiral Smyth in his *Sailor's Word Book* defines "sasse" as a kind of weir with a flood-gate and movable sluice.

[2] Cf. *Lives of the Engineers*, vol. i., p. 457, which contains Brindley's Report on this subject—an interesting document, published for the first time by Dr Smiles.

from the first the bases on which our inland navigation system was constructed. As is shown in the little work by Zachary Allnutt mentioned in the last chapter,[1] the lower Thames was connected with the Colne at East Mersea, the Blackwater at West Mersea, the Crouch at Foulness, the Medway at Sheerness, the Thames and Medway Canal at Gravesend, the Darent River at Purfleet, the Lea at Bow Creek, the Grand Surrey Canal at Greenland Dock, the Limehouse Canal at Limehouse, the Grand Junction at Brentford, and the Wey at Weybridge; while the Upper River was united with the Kennet and Avon navigation at Reading, the Wilts and Berks at Abingdon, and the Thames and Severn Canal at Lechlade. Similarly, the Severn was joined by the Swansea Canal, the Neath River and Canal, the Cardiff Canal, the Usk, the Avon, the Wye, the Stroud Canal, the Hereford Canal, the Berkeley and Gloucester Canal, the Warwick Avon, the Worcester and Birmingham Canal, the Droitwich Canal, the Stour, the Stafford and Worcester and Leominster Canals, the Shropshire Canal, and the Ellesmere Canals; and in the north the Mersey and Humber became the main arteries of a corresponding network of canals. The multiplication of canals, while it thus stimulated the trade of such river navigations as were connected with them, does not appear to have inflicted much injury on those which were independent; and in 1804 we find William Jessop, one of the most eminent engineers of his day, who was employed in the construction of the Trent and Aire and Calder navigations, the

[1] *Useful and correct accounts of Rivers and Canals west of London*, pp. 3-4.

Caledonian and other canals, and who surveyed both the Thames and the Severn,[1] pointing out in one of the *Georgical Essays* published in 1804, that, "while canal navigations are avowedly safe and easy except in times of frost," there are "numerous instances in which river navigations are preferable to them." The latter, he says, "are generally effected at the least expense"; and as their greater width and the smaller number of bridges enables vessels navigating them to use sails and dispense with horse towing, they are, provided obstructions are removed, also "susceptible of more expedition, except in the few weeks in which they are annoyed with floods." In proof of this he states that on the river Trent, "which compared with some others is very imperfect," goods are conveyed 70 miles for 8s. per ton, including freight, tonnage, risk and profit of the boat owners, the double journey of 140 miles being frequently accomplished in a week, including loading and unloading, by a vessel for ten weeks in succession, and that "there are few canal navigations on which the expense of conveyance is not half as much more."[2] Jessop, who was a pupil of Smeaton, also reported on the practicability of making a communication between the Witham and the town of Horncastle; on the feasibility of making a harbour for large vessels at Dunbury, and on the development of inland navigation in Ireland. When he wrote, canal companies must already have begun to lose

[1] Cf. *Lives of the Engineers*, vol. i., p. 198 note.

[2] Cf. *Essay II. on Inland Navigations and Public Roads*, pp. 81-2. The *Georgical Essays* were edited by Dr A. Hunter, F.R.S., who contributed some of the papers. Jessop adds that this rate of speed would often be maintained if vessels were not obliged to wait for their loading.

some of their traffic through the improvement in land transport resulting from the increasing construction of turnpike roads, for the creation of which over a thousand Acts were passed during the twenty-four years between 1785 and 1809,[1] and before the middle of the nineteenth century they were in turn rendered "obsolete" by the transfer of more than half the mileage of their undertakings and of the greater part of the capital invested in them to the railway companies, which effectually prevented competition with their own enterprises by allowing a large portion of the canals thus acquired to become derelict. On the other hand, natural waterways have recovered somewhat of their original importance through the increased trade which the development of the railway system has brought to the ports situated upon them; and while the only events in the history of canals during the last half century have been the construction of the Manchester Ship Canal, one of a class of artificial waterways entirely distinct from ordinary canals, and the improvement of one or two of the very few canals which, like the Aire and Calder, the Grand Junction, and the Weaver are still remunerative, the conservancy of navigable rivers has been steadily developing.

It has been mentioned that Brindley in demonstrating the advantages of canals compared water to a giant whom it was necessary to bind and lay on his back in order to utilise his strength; and, with the difference that the giant may in this case be said to be allowed the use of his limbs under the direction of

[1] Four hundred and fifty-two Turnpike Acts were passed between 1706 and 1744; 643 Acts between 1785 and 1800; and 419 between 1800 and 1809.

a master, the simile is equally applicable to the methods of conservancy adopted for dealing with the hindrances to navigation arising from the combined effects of the natural flow of a river and of tidal action on its bed and banks.

The sedimentary matter deposited by a river throughout its course to the sea, and the scour of its bed, gradually create shoals, which are either soft or hard according to the nature of the soil it traverses, and which, when the fresh water discharge is greater than the volume of the tide, frequently form a bar at its mouth. Again, the impact of the water on such portions of its banks as are soft produces continuous erosion resulting in a tendency to curvature which converts its course into a series of loops.[1] The course and direction of each river is, moreover, largely determined by the rapidity of its stream and the character of the geological strata underlying it, and while some rivers, like the Thames, Usk, and Clyde enlarge with fair regularity as they approach the sea, with what Mr Vernon Harcourt terms a "trumpet-shaped outlet," and are the most regular in width and the most uniform in depth, others, like the Mersey and the Tay, are contracted in width at or near their mouth and present also great irregularities in depth. Some estuaries again, like those of the Humber and Shannon, exhibit irregularities only in width, while others like the Tyne and Wear enter the sea directly without passing through any estuary. Lastly, though the tidal wave traversing our coasts places our rivers, which, owing to their small drainage areas would otherwise be of no value for ocean navigation, on a par with the largest of

[1] *Rivers and Canals*, vol. i., pp. 52, 55, 202-3, 246-47.

those of other countries, and is thus, as pointed out by Mr Vernon Harcourt, the chief cause of our commercial prosperity, tidal action may nevertheless prove as injurious as beneficial to navigable rivers unless it is properly regulated by conservancy. "The Thames, having a basin of $\frac{1}{82}$ that of the Danube, affords superior facilities for navigation at high water between the sea and London to those of the Sulima mouth ; the Mersey, with a basin only $\frac{1}{722}$ that of the Mississippi, is equally accessible at high tide up to Liverpool as the South Pass ; the Ribble, with a basin $\frac{1}{58}$ that of the Rhone, is of more use for navigation than the Rhone outlet ; and the Usk, with a basin only $\frac{1}{888}$ that of the Volga, has nearly double the depth, in its navigable channel at high water of fair neap tides up to Newport, which it is hoped may be obtained by dredging at the most favourable Volga outlet, and about three times the present available depth in that river from the Caspian Sea up to Astrachan."[1] This tidal wave, however, which in earlier times penetrated much further and converted places like Deeping on the Welland and West Dean on the Cuckmere into ports, tends to create a ridge of submerged beach in the line of the greatest scour of a river, which, forming in front of its outlet, stretches out seawards curving round to join the foreshore on either side.[2] The formation of these bars, whether fluvial or marine, must have been facilitated by the diminution in

[1] Vol. i., pp. 234-36.

[2] *Rivers and Canals*, vol. i., pp. 202-3. Cf. *Tidal Rivers, their Hydraulics, Improvement, and Navigation*, by G. W. Wheeler, pp. 148, 155, 162 ; *A Treatise on the Improvement of the Navigation of Rivers with a New Theory on the Cause of the Existence of Bars*, by W. A. Brooks, M.I.C.E., pp. 19, 66 ; and *River Bars*, by S. J. Mann, Assistant Engineer to the Dublin Port and Dock Board.

volume and rapidity of our rivers, and where it has been unchecked has resulted in the silting up of some of them, such as the two branches of the Lymne or Rother which originally entered the sea at Lymne and West Hythe. This process may now be seen in operation at the mouth of the Cuckmere in Sussex, and in the case of the Adur in the same county it has not only led to the transfer of the original port of Old Shoreham to New Shoreham, but has also twice —in 1760 and 1819—necessitated the cutting of a new outlet for the river some 3½ miles east of the town.[1] The Cheshire Dee, which in 1684 had still a good wide direct channel near the Cheshire shore, began to show similar signs of silting up before the close of the seventeenth century; and the navigation of the river is still very defective owing to the fact that the River Dee Company, which was authorised in 1732 to reclaim a large tract of the adjoining lands in consideration of providing a channel 15 feet in depth at high water of spring tides up to Chester, has not only deprived the estuary of an area which, when the process of reclamation is complete, will amount to some 10,000 acres, but has also trained the river between parallel banks like a canal instead of improving the tortuous course below the city.[2]

[1] *Rivers and Canals*, vol. i., p. 219. The Adur was made navigable in 1807 under 47 Geo. III. c. 117. See Priestley's *History of Inland Navigation*, pp. 5, 6. *Cf.* Wheeler, p. 158. Similar results have occurred in the cases of the Axe, the Exe, and the Sid, the outlet of the last-named river being, like the Cuckmere, quite choked with shingle through which its waters percolate to the sea. See an interesting paper by John Thornhill, M.I.C.E., *Proceedings of Institute of Civil Engineers*, vol. vii., pp. 327 *et seq.*

[2] *Ibid.*, pp. 289-93. Mr Vernon Harcourt observes that the case of the Dee "serves as a warning of the fatal consequences of mixing

It is the object of river conservancy to remedy all these natural hindrances to navigation by lowering shoals to the minimum depth necessary to secure a fairly uniform flow, by guiding the course of a river in a definite and fairly direct channel, and by securing the freest possible admission into it of the flood tide and removing all obstructions to its progress up to the farthest practicable limit.[1] The simplest and formerly the only way of removing shoals is by dredging; but this is only effective in the case of such as are hard and permanent.[2] In order to remove soft shoals it is necessary to reduce the width of the channel along their site and thus increase the scour in order to prevent their forming anew; and this is effected either by erecting at intervals jetties projecting at right angles into the stream, or—as these, if sufficiently distant from each other to render the system economical, are apt to produce a circuitous course in the channel and to form shoals in the intermediate spaces — by means of longitudinal embankments of rubble, stone, or chalk following the course of the river, and fixing the width of the low water channel.[3] In addition to this, it is frequently

up schemes of land restoration with the improvement of navigation in the same estuary." *Cf.*, too, Wheeler's *Tidal Rivers*, pp. 377-84.

[1] *Rivers and Canals*, vol. i., pp. 52, 248. *Cf.* generally as to River Improvements, Wheeler's *Tidal Rivers, their Hydraulics, Improvement and Navigation; The Conservation and Improvement of Tidal Rivers*, by E. K. Calver; Stevenson's *Principles and Practice of Canal and River Engineering;* and the *Improvement of Rivers*, by B. F. Thomas, U.S., Assistant Engineer, Member of American Society of Civil Engineers, and D. A. Watt, U.S., Assistant Engineer, Member of the American Society of Civil Engineers. Though an American work, this treatise on River Improvement contains much information equally applicable to England.

[2] *Cf.*, as to various methods of dredging, *ibid.*, p. 71 *et seq.*

[3] *Ibid.*, pp. 54, 55.

necessary to protect the soft concave portions of river banks from the impact of the water by means of fascines, stakes, or stones, or projecting spars of brushwood at a low level; and where the course of a river has become unduly tortuous through the wearing away of the banks it is sometimes necessary to restore it to its original condition by cutting a direct channel where the current is gentle.[1] The principle of such "training works," as they are termed, is to guide the channel of a river right out to deep water in order to prevent accretion at the sides of the estuary,[2] but though valuable in fixing and deepening the channel of large rivers with a tolerably uniform flow, they are inadequate in case of those the discharge of which becomes very small in dry seasons;[3] and the regulation of rivers by raising the low water-level by means of locks and weirs to obtain the requisite depth for navigation not only affords greater scope for improving the navigable channels of smaller rivers, but also renders the up-stream almost as easy as the down-stream traffic on larger ones.[4] The locks built when this system of "canalisation" was first introduced at the close of the eighteenth century were constructed of timber, or sometimes with masonry walls at each end and merely a cutting with sides for the lock chamber, the slope being sometimes terminated above the low water chamber by a line of sheet piling, while the sluices were worked by means of a crowbar or winch. Some of the older varieties of locks are still in use on

[1] *Rivers and Canals*, vol. i., pp. 55, 56.

[2] *Ibid.*, p. 325. [3] *Ibid.*, p. 59.

[4] *Ibid.*, p. 46. Cf. *Improvement of Rivers*, by B. F. Thomas and D. A. Watt, pp. 67-74.

some of our rivers, such as the Warwick and Somerset Avons and the Wey, and an oarsman may therefore still trace the various stages in the development of canalisation by comparing them with those on the Thames. Owing to the liability of timber to decay, and its destruction through the rush of water from the sluices and the waste of water in locking due to the sloping sides of the old chambers, vertical walls of brickwork or masonry are now usually adopted throughout in the locks on large rivers, while the gate floors and aprons are also constructed of masonry and the sills and hollow quoins of granite[1]—improvements which may be seen in their greatest perfection perhaps at Teddington on the Thames, where there are now three locks, parallel to each other, for the respective use of pleasure boats, steamers, and barges. It may be added as an illustration of the delay in the realisation of schemes projected in Acts of Parliament, that though the original Act authorising the construction of Teddington lock provided that it should be furnished with an intermediate pair of gates —three pairs in all—this provision has for the first time been carried out in the new lock for barges which has been completed during the present year.[2]

By these various methods of conservancy, either singly or in combination, the navigation of numerous rivers has been considerably improved during the last century, and in some of these the regulation works are still in progress.

Among the rivers flowing into the Wash—in the case of which the small fall of the land throughout

[1] *Rivers and Canals*, vol. i., pp. 102-3. Cf. *The Improvement of Rivers*, pp. 146-98.

[2] 1904.

the fen country necessitates the construction of numerous straight drains for the discharge of the inland water to supplement the straightening and embankment of their course[1] — the outfall of the Witham for 3 miles between Boston and Hobhole was so improved by training works some seventy years ago, that the flood tide reaches the former place one and a half hours earlier than formerly, and vessels of the largest draught are enabled to get up to the haven. More recently these works were continued to the junction of the river with the Welland, in which, owing to similar improvements, the low water-level was lowered 7 feet at Fosse Dyke Bridge —a work unfortunately discontinued for want of funds. The low-water level of the Ouse has been similarly lowered by about 9½ feet, and the navigation both above and below King's Lynn considerably improved;[2] while, by works begun as early as 1770, and extended in 1827-30, the navigation of the Nen has been improved as far as Wisbeach, and the low water-level lowered more than 10 feet, though the channel beyond the training works is still somewhat shallow and tortuous in the estuary.[3] In the case of the Dee, as already stated, training works have, owing to their unsuitability, proved only partially successful,[4] but in that of the Ribble they have resulted in forming a permanent channel in place of a wandering one, and it is hoped that

[1] *Rivers and Canals*, vol. i., p. 284.

[2] *Ibid.*, vol. i., p. 288. *Cf.*, as to the Witham, Wheeler's *Tidal Rivers*, pp. 398-405, and Jeans' *Waterways and Water Transport*, p. 33; and as to the Nen and Ouse, *ibid.*, p. 34. Among the Acts relating to the Welland may be noted, 50 Geo. IV. c. cxcvi., and 14 and 15 Vict. c. cxxxvi.

[3] *Ibid.*, p. 289.

[4] See *ante*, p. 146.

ERRATA

Page 150, note 2, line 4, *for* 50 Geo. IV. c. xlvi. *read* 5 Geo. IV. c. xlvi.

Page 151, note 3, line 5, *for* 48 Geo. IV. c. xlviii. *read* 48 Geo. III. c. xlviii.

dredging operations begun in 1890 will enable vessels drawing 17 feet to navigate the river at spring tides between Preston and Lytham.[1]

The efficacy of dredging has been largely increased by modern inventions, and the improvement of other rivers has been generally effected by this means. Thus, the depth of the Tees, which in 1851 was only 8 feet over the bar outside the mouth of the river at low water spring tides, has been so greatly increased, that since 1878 vessels of from 1000 to 3000 tons have been able to leave Middlesboro' fully laden and proceed to sea drawing 21 feet of water;[2] while that of the Wear has been increased from 4 feet at low water in 1888 to 11 feet in 1892.[3] The Usk, under an Act obtained by the Newport Harbour Commissioners in 1890, is being sufficiently deepened to ensure a minimum depth in the main channel at high water of the lowest neap tides of 24 feet from Newport Bridge to the entrance of the Alexandra Docks, and 26 feet for the remainder of the channel down to the mouth of the river.[4]

[1] *Rivers and Canals*, vol. i., p. 293 *et seq*. *Cf.* Wheeler's *Tidal Rivers*, pp. 384-98, and Jeans' *Waterways and Water Transport*, pp. 31, 32. The principal Act is 52 and 53 Vict. c. cxxiii.

[2] *Ibid.*, pp. 268-69. *Cf.* Wheeler's *Tidal Rivers*, pp. 353-61, and *Waterways and Water Transport*, pp. 34, 35.

[3] *Ibid.*, p. 214. See too "An account of the progressive improvement of Sunderland Harbour and the River Wear," by John Murray, M.I.C.E., *Proceedings of Institution of Civil Engineers*, vol. vi., p. 256 *et seq.*, and *Waterways and Water Transport*, p. 36. The series of Acts relating to the Tees begins with 48 Geo. IV. c. xlviii., and ends with 55 and 56 Vict. c. xxvii., and of those relating to the Wear the first is 9 Geo. IV. c. xli., and the last 40 and 41 Vict. c. xl.

[4] *Ibid.*, pp. 271-74. The Acts improving Newport Harbour range from 32 and 33 Vict. c. cxviii. to 56 and 57 Vict. c. xxvi.

The navigation of the Tyne for 19 miles from its estuary to Hedwin Streams, 8¾ miles above Newcastle, has been so improved since 1861 by dredging, and by the construction of two breakwaters on either side of the river mouth, that there is now a depth of 24 feet at low water of spring tides at the outlet, where in 1860 vessels were liable to be detained two or three months by the reduction in depth over the bar during easterly winds, and a depth of 30 feet throughout, between Shields and Newcastle, where formerly steamers of 3 to 4 feet draught used to ground for hours. While, however, dredging operations have in this case so greatly conduced to the increase of trade and shipbuilding in the Tyne that its ports now rank next to Liverpool and London,[1] they have hitherto been only very partially successful in the Mersey, which in conjunction with the Weaver drains an area of 1723 square miles, and flows through an extremely irregular estuary to the sea. This river still apparently retains some of the characteristics ascribed to it in 1709 in the first private Act relating to the port of Liverpool (8 Anne c. xii.), which after reciting that the city was "an ancient borough sea-port and corporation enjoying divers and ancient rights and privileges," some of which date back to the reign of Henry V., states that the "entries" [*sic*] into the Mersey had been found so difficult and dangerous that "great numbers of strangers and others had frequently lost their lives as well as their ships and goods for want of proper

[1] *Rivers and Canals*, vol. i., pp. 213-14, 262-64. *Cf.* Wheeler's *Tidal Rivers*, pp. 343-53, and *Waterways and Water Transport*, pp. 29, 30.

land-marks, buoys, and other directions."[1] Narrow and winding near Warrington, it gradually expands below, only to contract again at the rocky gap of Runcorn. Below this it again widens out, increasing rapidly in width below Hale Head, opposite which the Weaver flows in, and attains its maximum width of about 3 miles in front of Ellcome Port, the wide inner estuary, together with the neck, having an area of 22,500 acres, of which 17,300 acres become bare at low water of spring tides, and forming a vast natural basin. Here it again contracts, and after flowing in a comparatively narrow channel with a minimum width of three-quarters of a mile between Liverpool and Birkenhead, it finally emerges at New Brighton into Liverpool Bay, and flows through sandbanks and over a bar into the Irish Sea. This bar, which appears to have gradually shifted seawards between 1840 and 1880, has since the latter year retrograded, and in 1890 it was more than half a mile inside of its position in 1880, and approaching the place it occupied in 1870, and dredging operations for its removal are still in progress.[2]

In the case of all the rivers above described the

[1] *History of Private Bill Legislation*, pp. 474-75. This Act was amended in 1715 (3 Geo. I. c. 1), and in 1811 (51 Geo. III. c. cxliii.) the Liverpool Docks were vested in the Corporation as trustees. In 1851, by 14 and 15 Vict. c. lxiv., the docks both at Liverpool and Birkenhead were consolidated into one estate, and the control and management vested in a public trust for the Mersey Dock and Harbour Board consisting of eighteen members selected by the dock ratepayers, and three nominated by the conservancy commissioners; and in 1850 there was a consolidating and amalgamating Act which has been followed by many others. *Ibid.*, p. 475.

[2] *Rivers and Canals*, vol. i., pp. 274-80. Cf. *Waterways and Water Transport*, pp. 26-28, and Wheeler's *Tidal Rivers*, pp. 361-77.

improvement thus effected by training works and dredging has been practically limited to their estuaries, and the greatest length of the navigable channel controlled by the respective conservancy authorities of any of them—that of the Tyne—is under 20 miles. It is only by means of canalisation that the upper course of rivers can be rendered suitable for navigation, and among the numerous rivers which have been thus dealt with many have now become parts of canal systems. Such are the Irwell, now the property of the Manchester Ship Canal Company;[1] the Weaver, which has been canalised for 50 miles between Northwich and Chester, and which, owing to a series of improvements, of which the last began in 1873, has now an average depth of 12 and an average width of from 95 to 100 feet;[2] and the Aire and Calder, the 85 miles, part river and part canal, of which have

[1] Owing to its being adapted only for light craft, the Irwell has now largely fallen into decay. It was acquired after its canalisation by the Bridgwater Canal Company from whom it passed with the other property of that company under the control of the Manchester Ship Canal Company. Jeans' *Waterways and Water Transport*, p. 35.

[2] The Weaver, as already noted (see *ante*, p. 80), was first made navigable in 1721 by 7 Geo. I. c. 10, which was followed by 7 Geo. II. c. 28; 33 Geo. II. c. 49; 47 Geo. III. c. 82; 7 Geo. IV. c. 29; and 10 Geo. IV. c. 70. In the nineteenth century improvements were made in the navigation, of which 30 miles are river and 20 canal, in 1830, 1860, and 1893, under the last named of which the number of locks on the 20 miles of artificial waterway was reduced to *four*, the larger of each pair of locks being 220 feet long by 42 feet 6 inches wide, and having 15 feet of water on the sills. The principal article of transport is salt, of which over a million tons pass annually down the Weaver to the Mersey, but a considerable trade in coal, timber, cotton, flint, and clay is carried on over it with the Potteries. See Jeans' *Waterways and Water Transport*, pp. 28, 29, and Priestley's *History of Inland Navigation*, pp. 706-8.

been much improved since 1860 by the construction of locks 215 feet long and 22 feet wide, with 9 feet of water on the sills.[1] Canalisation has, however, played an important part in the improvement of the Thames and the Severn, though dredging and training works have also been employed in the case of both these rivers.

It has been mentioned in a previous chapter that the earlier Acts relating to the Severn provided only for what may be termed its "policeing" and the abolition of charges attempted to be levied on vessels by Worcester and other river-side towns.[2] No proposals for the improvement of the navigation appear to have been made before 1766, when this was advocated by Whitworth, the author of *The Advantages of Inland Navigation*, who, as member for Staffordshire and the owner of an estate adjoining the river, possessed special local knowledge on the subject. "There is no river," he says, "that has such a length of navigation as the Severn; you may navigate a vessel of 50 tons, and not a lock the whole way, 200 miles up to Welshpool, except in an excessive drought"; and he goes on to state that though there were various shallows which impeded the navigation in summer between Tern Bridge and Bridgnorth, Bridgnorth and Bewdley, and Bewdley and Redstone Ferry, these could easily be removed at the cost of £10 apiece. Their continued existence was due, he considered, to the fact that the persons navigating the river "live at various places and are not connected in a body

[1] Cf. *Encyclopædia Britannica*, Art. "Canal," by Sir Leader Williams.

[2] *Cf.* chap. iv., p. 48.

sufficient to agree to remove these shallows, or to apply to Parliament for an incorporation for such a purpose," and he proposed that his suggested Tern Bridge Navigation Company should be empowered to lay out any sum not exceeding £1000 for deepening, scouring, and widening the river between Shrewsbury and Worcester.[1] This project, however, shared the fate of the larger one for uniting the Humber, Mersey, and Severn of which it formed part; and, owing presumably to the continued apathy of those most concerned in the matter, a Bill embodying proposals for making the river navigable from Diglis in Worcestershire to Coalbrook Dale in Salop for vessels drawing 4 feet of water, which were made by Jessop in 1784-85, also failed to become law.[2] In 1790 the Stafford and Worcester Canal Company obtained an Act (30 Geo. III. c. 75) empowering them to deepen the shoals below Stourport and Diglis at their own expense; and between 1830 and 1840, after a survey of the river between Gloucester and Stourport by Mr Thomas Rhodes, C.E., a company, entitled the Severn Navigation Company, was established for bringing up to Worcester sea-borne vessels drawing 12 feet of water, which, however, failed to carry out the project for which it was incorporated. As much

[1] Cf. *Advantages of Inland Navigation*, pp. 53-54.

[2] *Report to the Admiralty upon the improvement of the Severn Navigation Bill*, 1848, *under the Parliamentary Inquiries Act*, 8 *and* 9 *Vict. c.* 106. *Cf.*, as to the earlier history of the Severn, Priestley's *History of Inland Navigation*, pp. 594-97; and as to its state at the close of the eighteenth century, *A General View of the Agriculture of Shropshire*, by Joseph Plymley, Archdeacon of Salop, pp. 284-333, which contain an account of the river, by Telford, together with tables giving the daily water-level during 1789 and 1800.

as £70,000 appears to have been spent in promoting and opposing the various schemes during the preceding ten years, but at length, after the expenditure of an additional £12,533 by the promoters, an Act was passed in 1842 (5 Vict. c. 24) for "improving the navigation of the Severn from the entrance lock on the Gloucester and Berkeley Canal, and from the entrance lock on the Herefordshire and Gloucestershire Canal in the county of Gloucester to Gladders or Whitehouse Brook in the county of Worcester." This Act (amended later by 7 Vict. c. 10; 8 and 9 Vict. c. 184; and 9 and 10 Vict. c. 291), provided for the appointment of thirty commissioners representing the different interests connected with the river—principally the justices of Gloucestershire and Worcestershire and the town council of Gloucester, but also including members of the corporations of all the towns on the banks of the river from Bristol to Wenlock in Salop—for controlling the navigation; and this body still regulates the conservancy of this portion of the Severn.[1] In the same year the navigation of the river was improved by the erection of regulating weirs[2] placed obliquely to the stream in wide places, and by the

[1] *Report*, pp. 11-13.

[2] These weirs—which were solid masses of stonework extending obliquely down stream, without any sluice, or floodgate, or falling board—appear to have been admirably adapted for their purpose of facilitating navigation during floods, and Mr Williams, a former engineer of the commissioners, stated that he had seen a whole train of vessels half a mile long behind a steam tug being taken over them "without knowing where it was." Their success led to their adoption on the Shannon where, however, they proved a complete failure owing to the different character of the floods and the nature of the river bed. See a paper by Mr James Lynam, C.E. of Ballinasloe, read at the Congress of the Society of Arts on *Water-Supply, Sewage, and Health*, in 1878. *Proceedings*, pp. 105, 106.

removal of numerous rocky shoals.[1] Finally, in 1890 the commissioners obtained an Act empowering them to raise £30,000 for canalising the 42 miles between Stourport and Gloucester, a work designed by their late engineer Mr Henry J. Marten, and carried out by him and his son and successor Mr E. D. Marten, the importance of which is enhanced by the fact that by means of the Stafford and Worcester Canal, which enters it at Stourport, and the Worcester and Birmingham Canal, which enters it at Worcester, the Severn is connected with the Mersey and the whole of the canal system of the north of England, including the Manchester Ship Canal.

This section of the Severn forms the second of the four of which—as pointed out in an interesting paper on the subject read by Mr E. D. Marten at the Birmingham Conference on Canals in 1895[2]—it may be regarded as consisting, the first being the uncanalised river from its source in the Plynlimmon Range to Stourport a portion of which, from the Shropshire coalfields downwards, is navigable in winter though but little used. The third section is the tidal estuary 26 miles in extent from Gloucester to Sharpness, the dangers arising from the tortuous course and shifting sands of which are increased by the tidal wave known as the "bore," which is caused by the shallowness of the lower part of the river. Being suddenly checked in its progress by the steep rise in the river bed, the "bore"—which in

[1] Cf. *Rivers and Canals*, vol. i., pp. 109-10, and a paper by Mr G. Edwards, *Proceedings of Institution of Civil Engineers*, vol. iv., pp. 361 *et seq.*

[2] Cf. *Report of Proceedings*, pp. 83-94.

the entrance of the Bristol Channel has a range of only 25 feet at springs, but is increased in momentum and altitude by the funnel-like shape of the channel through which it is forced—breaks and falls over in the section above Sharpness Point so as to form a rolling wave similar to a surf wave on a sea beach, and, travelling with considerable velocity after reaching the upper level of the river, causes much injury to the banks and hindrance to navigation when it encounters obstructions or inequalities in the width of the channel.[1] The necessity for navigating this section of the river has, however, as pointed out in a previous chapter,[2] been removed since 1827 by the construction of the Gloucester and Berkeley Ship Canal, which also effects a saving of 10 miles in distance; and the fourth section of the river — that from Sharpness to the Bristol Channel — is practically an arm of the sea.[3]

Having regard to its length and navigability, the paucity of legislation affecting the Severn presents a striking contrast to the abundance of that relating to the Thames, which river has been the subject of some thirty-two Acts, ten of which are public and general Acts, since the passing in 1624 of the 21 Jas. I. mentioned in a previous chapter.[4] As is pointed out, however, in the Report of the recent Royal Commission on the Port of London, it is

[1] *Admiralty Report*, 1848, p. 9; and *cf.* a paper on the Estuary of the Severn, by William Parkes, M.I.C.E. *Proceedings of the Institution of Civil Engineers*, vol. v., p. 300 *et seq.*

[2] Chap. vii., pp. 122-23.

[3] *Cf.* Mr Marten's paper above referred to; *Report*, p. 8; and *Waterways and Water Transport*, pp. 32, 33.

[4] Chap. v., p. 63-4.

largely owing to the fact that that Port is traversed by the Thames—"a long and sheltered tidal river, conveniently situated for trading with the various coasts of this country, with the continent, and with other parts of the world"—that London has attained the position of the central city of the British Empire.[1] The Thames has thus always demanded especial attention on the part of the Legislature, and it is probably owing to this fact that it is the only river in the United Kingdom which is under the control of a single conservancy authority from its source to the sea.

The Act of 1624 was the first of a series relating to the upper river, by the two most important of which passed in 1750 and 1771,[2] its conservancy was vested in commissioners "for the prevention of exactions and abuses," who were empowered to purchase land for making the necessary works and towing paths and to make further regulations with respect to traffic. Under the powers thus conferred on them, which were extended by amending Acts of 1775, 1788, 1795, and 1812,[3] the commissioners expended £60,000, together with the surplus of the tolls, on the erection of twenty-four pound locks and other improvements in the river between Lechlade and Staines, a distance of over a 100 miles, the cost of the fifteen locks from Mapledurham to Boulter's lock being £1000 per mile.[4] It appears

[1] Cf. *Report*, p. 13.

[2] 24 Geo. II. c. 8, and 11 Geo. III. c. 45.

[3] 15 Geo. III. c. 11; 28 Geo. III. c. 51; 35 Geo. III. c. 106; and 52 Geo. III. c. 67.

[4] Cf. *Considerations on the best mode of improving the present imperfect state of the navigation of the river Thames from Richmond to Staines*, by Zachary Allnutt, p. 14.

from the reports of Mr Jessop,[1] by whom the first six locks on the river were constructed, and of Mr Mylne, respectively presented to the commissioners in 1789 and 1791, and from a report by a committee of five commissioners appointed in the latter year to consider some differences as to details between the two engineers, that the navigation at first suffered considerably from the enforcement of private rights with respect to mills and fishing weirs, and the delays caused and exorbitant tolls demanded by the millers and fishermen who managed the locks.[2] By 1804 however, these and other defects in conservancy had been remedied; for a petition presented to the City of London on the 6th December in that year by the "Barge-masters and Navigators and other persons frequenting and particularly interested in the further improvement of the Thames Navigation," after setting forth the difficulties and dangers of the river between Staines and Richmond, states that the navigation of the upper river had been rendered "safe, certain, and cheap by means of weirs, side cuts, and pound locks," and suggests that similar steps should be taken with respect to the lower river.

The corporation, who claimed the conservancy of the river from Staines to Yantlett Creek under 17 Ric. II. c. 9—a claim however frequently contested by the Crown—had obtained two Acts in 1774 and 1777[3] to enable them "more effectually to improve

[1] Cf. *Reports of the Engineers, Mr Jessop and Mr Mylne, appointed by the commissioners of the river Thames and Isis to survey the state of the said navigation from Lechlade to Day's lock . . . to which are added some orders of the commissioners on the said Reports* (1791), pp. 4, 28, 29, 30, 34. [2] *Ibid.*

[3] 14 Geo. III. c. 91 and 17 Geo. III. c. 18.

and complete the navigation of the river Thames westward of London Bridge within the liberties of the City of London." They had, however, apparently no power under these Acts to erect weirs actually across the river, and it is pointed out in the petition above mentioned that the "jetties" or "weir hedges" by which they attempted to improve the navigation were not only inadequate as a remedy, but also created "very rapid and dangerous currents at high water times without causing, in short water times, a sufficient depth to navigate 18 inches in the upper districts," which also suffered from the want of water caused by the "flashes" run twice a week in summer from Sonning, to float barges over the shallows in the lower reaches. In his "considerations" on the best mode of improving this part of the Thames, published in 1805, Zachary Allnutt, the solicitor to the petitioners and also superintendent of the second and third districts of the upper river, after pointing out that the corporation had during the previous five years been expending annually £1400 on these defective methods of conservancy, while the corresponding outlay of the upper river commissioners on an extent of navigation five times greater in length had been only £3000, suggests that they should obtain powers for erecting locks at Penton Hook, Laleham, Shepperton, and between Kingston Bridge and Teddington Ferry. He estimates the cost of these improvements at £20,000, which he proposes should be raised by the imposition of tolls of 3d. per ton per voyage; and the passing of an Act in 1810[1] for "amending, altering, and enlarging" the powers conferred on them by the Acts of 1774 and 1777

[1] 50 Geo. III. c. 204.

above mentioned, and the completion of Teddington lock in 1811, seem to show that his suggestions must have been well received by the corporation.[1]

The river "below bridge" has always been treated as entirely distinct from the portion of it "above bridge," within the jurisdiction of the city, and, owing largely to a petition presented to Parliament in 1796 by the West India merchants complaining of the inadequate accommodation in wharves and docks to meet the great increase of commerce,[2] an Act was passed three years later for "rendering more commodious and better regulating the Port of London,"[3] the legal customs limit of which then extended[4] from London Bridge to the North Foreland in Kent, and the Naze in Essex, but, as defined by Orders in Council under the Customs Acts, now begins at a line drawn from Havengore Creek in the latter county to Warden Point in the Isle of Sheppey.[5] This statute was amended by numerous subsequent Acts,[6] but no serious attempt appears ever to have been made to improve the navigation of this portion of the Thames till it was transferred from the control of the Corporation to the Thames Conservancy in the middle of the last century. The numerous embankments for pro-

[1] Cf. *Considerations*, etc., pp. 8, 11, 12, 15, 41, 43.

[2] *Cf.* Humpherus, vol. ii., p. 412.

[3] 39 Geo. III. c. 119, amended by 42 Geo. III. c. 49 (1802), 43 Geo. III. c. 53 (1803), 45 Geo. III. c. 31 (1807), 10 Geo. IV. c. cxiv. (1824), 4 and 5 Will. IV. c. 32 (1834), 8 and 9 Vict. c. 86 (1845), 12 and 13 Vict. c. 90 (1849).

[4] 13 and 14 Car. II. c. 2.

[5] Cf. *Report of Royal Commission on the Port of London*, 1902, pp. 13, 42.

[6] 52 Geo. III. c. 45; 54 Geo. III. c. 223; 5 Geo. IV. c. 123; and 5 Vict. c. 1.

tection against overflow, which from the earliest times have been gradually erected along the banks, up creeks and tributary streams, round islands and about marshes, and which — irrespective of the modern Victoria, Albert, and Chelsea embankments, respectively erected in 1864-70, 1865-68, and 1871-74 —have been estimated to have a total extent from London to the river mouth of over 300 miles,[1] have doubtless tended to regulate the flow of the river, and its natural scour is almost sufficient to maintain the depths of the channels. In the outer estuary between Thorney Creek and the Nore Lightship, which is 8½ nautical miles in length, with a low water width of from 1400 to 400 yards, the position and depth of some of these channels is from time to time affected by natural causes such as the action of gales on sandbanks. The Thames, however, has no "bar," and, as stated by Sir Alexander Binnie in his evidence before the Royal Commission on the Port of London, "so great are the natural advantages of the river that little has been done, except some desultory dredging, to improve its condition since those almost prehistoric times when it was originally embanked."[2] These dredging operations, undertaken by the Thames Conservators, have resulted in increasing the depth of the river up to Gravesend to 26 feet, and thence to the Albert Docks to 22 feet;[3] but, though their removal has been recommended in 1894 by the Thames Naviga-

[1] Cf. *Lives of the Engineers*, vol. i., p. 80.

[2] *Bankside* suggests a reminiscence of these embankments, one of the most notable of which was that at Daggenham, erected by Captain Perry in 1707. *Ibid.*, pp. 12, 79, 81.

[3] Cf. *Report of Royal Commission on Port of London*, Qu. 3045, p. 13.

tion Committee, and in 1902 by the Royal Commission on the Port of London, the Leigh middle shoals, which extend for a distance of 7 miles from near Shoeburyness to Canvey Island, still constitute a somewhat formidable obstruction to navigation.[1] The present depths of the waterway are considered insufficient by the owners of large steamers,[2] but it was stated in the Report of the Royal Commission on the Port of London in 1902 that, though the evidence submitted to them leaves no doubt in their minds "that far greater works than desultory dredging are now needed," the necessity for them is attributable "only in a slight degree if at all to any positive deterioration in the river channels," and has mainly arisen through "the revolution brought about by the rapid growth in the size and draught of ocean-going ships, and to the demand for rapid despatch."[3]

Be this as it may, however, the Conservators have now obtained power, under an Act passed in August 1905,[4] to provide a channel between the Nore and Gravesend, 21 miles long, 30 feet deep at low water of ordinary spring tides, and 1000 feet wide; and it has been estimated that the total cost of the work will amount to £375,000, and that it will be completed in three years.

The traffic on the Thames—and consequently the conservancy of navigation — must necessarily have been seriously affected by the rapid decline of that on the various canals connected with it

[1] Cf. *Report of Royal Commission*, p. 14, and App. A, p. 126.
[2] Cf. *Encyclopædia Britannica*, Art. "Thames."
[3] Cf. *Report*, p. 13.
[4] See 5 Ed. VII. c. cxc., sec. viii.

which resulted from the introduction of the railway system, and by the middle of the last century the locks between Cricklade and Staines had fallen into such a dilapidated condition that their use not only involved risk to vessels, but also the failure of water power for the mills to which the weirs were in most cases attached. Dues, termed "old lock tolls," were exacted for locks that had long ceased to exist, and the bed and surface of the river were covered with weeds, the growth of which was formerly kept down by the barge traffic. On the lower river, navigation was hindered by the non-removal of wrecks and obstructions, and also by the increase of shoals caused by the removal of old London Bridge; by the practice—especially common in the docks—of throwing mud and refuse into the river; and by the discharge of sewage into it by nearly all the towns on its banks, which began about 1850.[1] The neglect of their functions by the City and the Upper River Commissioners evidenced by these abuses led to the transfer of their powers and works, by the Thames Conservancy Acts 1858 and 1864, and the Thames Navigation Act 1866,[2] to a Board of twenty-three Conservators representing the City and the Upper River Commissioners; the Privy Council, Admiralty, Board of Trade, and the Trinity House; and the dock-owners and wharfingers, owners of passenger steamers, and owners of steam tugs and lighters. By these and

[1] The authors are indebted for these facts to the courtesy of Mr J. Gough when Secretary to the Thames Conservators appointed in 1857.

[2] 21 and 22 Vict. c. 147, and 27 and 28 Vict. c. 113; 29 and 30 Vict. c. 89.

other amending Acts,[1] the Conservators were, to quote the late Lord Cairns, constituted "guardians as it were of the navigation of the Thames and proprietors of the bed and soil of the Thames for the purposes of navigation,"[2] and in addition to the duties discharged by their predecessors, were entrusted with those of checking pollution in the river and its tributaries within a radius of ten miles on either side of it. The thirty-six locks and weirs between Cricklade and Teddington, nineteen of which were entirely rebuilt, were placed in good working order, the mills attached to them being transferred to the Conservators, the lock dues definitively fixed, and the weeds and obstructions on the upper river removed. The channels and berths occupied by vessels on the lower navigation were deepened and dredged, and the practice of casting mud and refuse into the river was checked by means of inspection and prosecutions; while provision was made for embankments and steam-boat landings, and mooring chains and buoys for ships, the annual revenue from the grant of embankments rising from £1000 in 1857 under the Corporation to £6000 in 1882 under the Conservators. Pollution by sewage and other refuse was largely diminished, and, in consideration of payments made by them

[1] The Thames Conservancy Act 1867 (30 Vict. c. 101); Thames Navigation Act 1870 (33 and 34 Vict. c. 149); the Thames Conservancy Act 1878 (41 and 42 Vict. c. 216); the Thames Act 1883 (46 and 47 Vict. c. 79); and the Thames Preservation Act 1885 (48 and 49 Vict. c. 76). The dispute between the City and the Crown as to the ownership of the soil of the lower river was, after a Chancery suit which lasted twelve years, formally vested in the Crown and transferred to the Conservators by the Thames Conservancy Act of 1857 which incorporated them.

[2] Cf. *Lyon* v. *Fishmongers' Co.*, 1. App. Cas., 662.

to the Conservancy Fund, the six water companies then supplying the metropolis were enabled by application to the Conservators to prevent the construction of works likely to interfere with the purity of their intakes, while the powers with respect to fishery inherited by the Board from the City were extended and enforced by bye-laws.[1]

Though, however, the Board thus succeeded in laying the foundations of a comprehensive system of conservancy, their operations were considerably hampered by the inadequacy of their funds and the limitations of their authority. Though they were all represented on the Board, the Trinity House, the Admiralty, the Board of Trade, the Chartered Dock Companies, and the Watermen's Company each possessed an independent though limited jurisdiction over the lower river, as did also the Conservators of the Medway, the Trustees of the Lea, the Commissioners of Sewers, and the Metropolitan Board of Works; while on the upper river the jurisdiction of the Conservators was concurrent with that of the Thames Valley Drainage Commissioners. The impediments to efficient administration resulting from the existence of these numerous authorities were increased by the Legislature, which, after imposing the duty of "dredging, cleansing, and scouring the river" on the Conservators in 1857, in the following year empowered the Metropolitan Board of Works, under the Main Drainage Act 1858, to pour daily 120,000,000 gallons of undiluted sewage

[1] Cf. *Reports of the Thames Conservators*, 1857 *et seq.*, and an Article in the *London Quarterly*, 1883, No. cxix., pp. 43-4, on River Conservancy, by the authors.

into it in the vicinity of Woolwich,[1] which in conjunction with the road detritus discharged by the Board in pursuance of their work as highway authorities at the entry of the Port of London, threatened in 1877 to form a bar at Barking, and reduced the available depth at low water between Gravesend and Woolwich to 15 feet.[2] With a similar disregard of the power with which it had invested the Conservators for the purposes of navigation, it authorised the Thames Valley Drainage Commissioners by the Thames Valley Act 1871 to construct works for the drainage, embankment, and irrigation of 55,472 acres of land between Cirencester and Long Wittenham for the prevention of floods in the Upper Thames Valley; while it neglected to provide any machinery for this purpose between Long Wittenham and London, and delayed until 1879 to give the Metropolitan Board the powers necessary for providing protection against overflow in London itself.[3] In addition to this, it ignored for some fifteen years the recommendation made by the Thames Traffic Committee, 1879, that the powers and duties of the Conservators should be considerably extended;[4] and it was not till after the functions of the Metropolitan Board had been transferred to the London County Council, and the administrative Councils of the Counties and Boroughs situ-

[1] See a paper on *The Thames and its Tributaries*, by Mr Cresswell, read at the Congress on National Water-Supply, Sewage, and Health, convened by the Society of Arts, May 1878, *Proceedings*, p. 129.

[2] Cf. *House of Lords Committee on Conservancy Board*, 1877 (evidence of Mr Bailey Denton), pp. 228, 229.

[3] Cf. *Report of House of Lords Committee on Thames Floods Prevention*, 1877.

[4] Cf. *Report*, pp. 33, 34.

ated on the banks of the river had been created by the Local Government Act 1888, that this recommendation was at length adopted. By the Thames Conservancy Act 1894,[1] which consolidates the law and repeals all previous statutes, the original Conservancy Board has been re-constituted under the title of Conservators of the River Thames, and made more fully representative of all the numerous bodies having interests in the river, the number of Conservators being increased to thirty-eight. Of these, the Admiralty, the Board of Trade, and the Trinity House each appoint two members. The original jurisdiction of the City may be said to be represented by the Common Council and the London County Council, each of which appoint six conservators; and that of the Upper River Commissioners by the County Councils of Gloucestershire and Wiltshire,[2] of Oxfordshire, Berkshire, Buckinghamshire, Surrey, Middlesex, Essex, and Kent, and by the Borough Councils of Oxford, Reading, and West Ham, each of which appoints one. The Metropolitan Water Companies[3] also appoint one conservator; and in addition to these thirty-one appointed members, the Corporation also comprises three conservators elected by registered shipowners, two elected by owners of sailing barges, lighters, and steam tugs, one elected by dock-owners, and one by wharfingers.[4] The jurisdiction of the Conservators now extends over the Thames and Isis from Cricklade to a line drawn from Yantlet Creek to the City stone opposite Canvey Island, "so much of

[1] 57 and 58 Vict. c. clxxxvii.

[2] These two counties appoint one member between them.

[3] Now represented by the London Water Board.

[4] Thames Conservancy Act 1894, sects. 8 and 9.

the Kennet as is between the common landing-place at Reading and the river Thames," and so much of the river Lea and Bow Creek respectively as are below the south boundary stones in the Lea Conservancy Act 1868.[1] The seaward limit of the Port of London is a line passing from a point near the Tower on Hammel's Naze in Essex to one about 5 miles from the North Foreland Lighthouse, the river channels between Yantlet Creek and the Nore Lightship seawards not being under any conservancy authority, though a portion of the fishery is under the control of the Kent and Essex Sea Fisheries Commission.[2] Broadly speaking, the duties of the Conservators, as described in the preamble of the Act, are to preserve and improve the Thames "for purposes of navigation for profit and pleasure, and as a source of water-supply for the metropolis and the suburbs thereof." For this purpose they are empowered, *inter alia*, to erect and maintain the banks, locks, and tow-paths; to dredge and scour and remove wrecks and obstacles in the river; to erect or licence the erection of piers and wharves; and to maintain and preserve the flow and purity of the river and its tributaries, including cuts, docks, and canals, and at the same time to carry out the arrangements made under the older Conservancy Acts with the Water Companies—now merged in the London Water Board—with respect to works calculated to interfere with their intakes. They may appoint harbour masters approved by the Trinity House to regulate the traffic on the river, the move-

[1] Thames Conservancy Act, 1894, sect. 3.

[2] *Report of Commission on the Port of London*, pp. 13, 14, and 16.

ments and position of vessels, and the manner of loading and unloading them, and place and maintain such beacons as are necessary for the navigation. Lastly, they are empowered to make bye-laws for carrying out the above and various other objects, including the protection, preservation, and regulation of fishery; the prevention of nuisances to riparian owners and of disorderly conduct on the river banks; the regulation of bathing; and the prevention of injury to birds and plants.[1]

Among the various bodies whose nominees are included among the Conservators of the river Thames, two demand a brief notice on account of their historical connection with the river and the part they still take in its management.

One of these is the "Company of Watermen and Lightermen," the early history of which has been described in a previous chapter,[2] which, though authorised officers of the Conservators are empowered to prefer complaints against its licencees before the court of Master Wardens and Assistants,[3] still retains its jurisdiction over all persons employed in the navigation of barges and boats in the Thames. The company has experienced many vicissitudes, one of the most notable of which was the destruction, by the Great Fire, of Watermen's Hall, which in 1647 stood in Cold Harbour in Upper Thames Street, and of all the records of the company.[4] In 1796 it was stated in the Petition to Parliament of the West India

[1] Thames Conservancy Act 1894, sects. 62, 66, 77, 78, 83, 85, 90-102, 109, 119, 126, 135, 190, 191, 291-98; and cf. *Report of Royal Commission on Port of London*, p. 34.

[2] Chap. v., p. 66. [3] Thames Conservancy Act 1894, sect. 134.

[4] *Cf.* Humpherus, vol. i., pp. 254, 299.

merchants already alluded to,[1] that the freemen of the company mustered 8283, the persons *not* free 2000, and the apprentices 2000—a total of 12,283;[2] and that the watermen still retained the spirit that made them so valuable in early wars, is shown by the facts that numbers of them joined the Walcheren Expedition of 1809 and Lord Exmouth's Expedition in 1816; and that in the historic encounter between the *Chesapeake* and the *Shannon*, Captain Brooke's life was saved by a waterman.[3] The introduction of the steam-boat system on the river, the first company in connection with which was established in 1814,[4] must have seriously affected the welfare of the craft, and, according to a return ordered by the House of Commons in 1836, the total number of freemen and apprentices had then fallen to 8000, of whom 5000 were working as lightermen, and only 3000 dependent for their living on their boats.[5] The Acts relating to the company were consolidated by an Act of 1827.[6] This was however repealed by a subsequent one passed in 1859,[7] which has itself been amended by the Thames Conservancy Act 1894; and under these Acts a lighterman is defined as any person navigating for hire a "lighter, barge, boat, or like craft,"[8] and a waterman as any person navigating a "passenger boat"—a term comprising any sailing boat, river

[1] Cf. *ante*, p. 163.
[2] *Cf.* Humpherus, vol. ii., pp. 412-17.
[3] *Ibid.*, vol. iii., pp. 81, 114, 136.
[4] *Ibid.*, vol. iii., p. 128.
[5] *Ibid.*
[6] 7 and 8 Geo. IV. c. 75.
[7] 22 and 23 Vict. c. cxxxiii.
[8] *Cf.* Sect. 3 of the Act of 1859, and 299 of the Act of 1894. Admiral Smyth, in his *Sailor's Word Book*, p. 446, defines a *lighter* as a large open flat-bottomed boat with heavy bearings employed to carry goods to and from ships. The *covered or closed lighter* has deck throughout for the protection of merchandise; and a *ballast-lighter* is one used to raise ballast from the bed of rivers and havens.

steam-boat, wherry or other like craft used for carrying passengers.[1] This legislation however has not affected the rights and obligations or the property of the Corporation,[2] which, unlike many old city companies, is almost entirely dependent for its revenue on the fees payable for the registration of barges, the binding of apprentices and freemen, and the licensing of watermen and lightermen. With the exception of £45,462 held in trust for the management of some charitable funds and almshouses for aged and decayed watermen and their widows, and for keeping a church in repair, the only property possessed by the company is their hall, its site, a couple of old houses, and some £6000 in consols; and the members of the court, who employ inspectors to watch the progress and conduct of apprentices, perform their duties without any remuneration.[3]

The second of the two bodies above mentioned is the Trinity House, whose rights as the chief pilotage authority in the United Kingdom are expressly recognised by the Thames Conservancy Act 1894,[4] and in whom the control of the buoys and lights in the whole of the navigable part of the Thames and its approaches both within and beyond the jurisdiction of the conservators is vested.[5] Though it is now a Government Department, "The Guilde Fraternitie or Brotherhood of the most glorious

[1] *Cf.* Sect. 33 of 22 and 23 Vict. c. cxxxiii.

[2] Cf. *Ibid.*, sect. 1.

[3] Cf. *Report of Royal Commission on Port of London*, pp. 55-9; and evidence of the secretary to the company (Mr Jacob), Qu. 1045-46 *et seq.*

[4] Sect. 216.

[5] *Cf.* Merchant Shipping Act 1894, sects. 618-19, *Report of Royal Commission on Port of London*, p. 126.

and undivided Trinity of St Clement in the parish of Deptford Strond, in the county of Kent," to give it its full ancient title, originated in a guild and almshouse for mariners founded by Sir Thomas Spert in 1511.[1] Like the Watermen's Company, its incorporation dates from the reign of Henry VIII., its first charter being granted in 1515, the year after that of the latter body;[2] and the original Trinity House at Deptford was, like Watermen's Hall, destroyed by the Great Fire, and, after being rebuilt in Water Street, was again burned down in 1715, when nearly all its records, like those of the Watermen's Company, were consumed.[3] The most important of the powers vested in the Corporation was that of licensing and regulating the pilots of ships, who were for the most part watermen who had qualified themselves for the work, and licensing sailors between their voyages to act as ordinary watermen on the river. By an Act of 1566,[4] which recites the incorporating charter, it was also empowered "to make erect and set up suche and so manye beakons markes and signals for the sea in suche place or places of the seashore and uplands near the seacoastes or forelandes of the sea, onely for sea markes, as to them shall seem most meete, needful, and requisite, whereby the dangers may be avoyded and escaped, and shippes the better come into their ports without peryll."[5] In 1665 Charles II. granted by letters patent to the Corporation, the ballasting of all vessels passing between

[1] *Cf.* Humpherus, vol. i., p. 69.
[2] *Cf.* Chap. v., p. 66.
[3] *Cf.* Humpherus, vol. ii., p. 99.
[4] 8 Eliz. c. 13.
[5] *Cf.* Humpherus, vol. i., pp. 75, 121.

London Bridge and the sea, and declared that their boats, lighters, and vessels, and their servants should be "free from press to serve His Majesty;"[1] and their powers as to erecting lighthouses and buoys were confirmed and enlarged by James II. in 1685.[2] The Trinity House was also originally entrusted with the control of the Government Navy Yard at Deptford, which was from early times a *rendezvous* for ships and seamen and was made a royal naval station in 1513. It has, however, long ceased to exercise these powers, and its principal duties now consist in the management and superintendence of lighthouses, beacons, and buoys in England and Wales and the Channel Islands, and the appointment and examination of pilots; and as regards the latter function, its London district comprises the waters of the Thames and Medway as high as London and Rochester Bridges respectively, and also "the sea and channels leading thereto and therefrom" as far as Orfordness to the north and Dungeness to the south.[3]

[1] Humpherus, vol. i., pp. 295-96.

[2] *Ibid.*, p. 352.

[3] *Cf.* Merchant Shipping Act 1894, sects. 617, 618, 669; and *Report of Royal Commission on Port of London*, pp. 47, 54.

CHAPTER X

RIVERS AND CANALS IN IRELAND AND SCOTLAND

Late development of conservancy of navigation in both countries. Chief rivers probably navigable from time immemorial. Celtic canoes and coracles. Early trade between Ireland and Mediterranean coasts ceased after fall of the Roman Empire. Industrial progress in both countries delayed till beginning of eighteenth century. Experience gained by engineers in England available on that account. Prominent part taken by the State in development of waterways. Inland navigation in Ireland initiated in 1715. Comprehensive character of the scheme. Its modifications. Large amount of public grants. Comparison between Irish and English waterways. Rivers and canals leased to companies. The Barrow, Lagan, Newry, Suir, and Foyle Rivers. The Grand, Royal, and Ulster Canals. Passenger traffic on Grand Canal. Expenditure on waterways vested in local trustees. The Bann River. The Ballynamore and Ballyconnell Canal, and the Lough Corrib navigation. Waterways controlled by the Commissioners of Public Works. The Maigue, Boyne, and Tyrone navigations. The Shannon. Development of inland navigation in Scotland impeded by physical difficulties. River improvement in Scotland. The Tay, Tweed, Clyde, Dee, and Forth Rivers. Clyde Improvement Act of 1759 contemporaneous with Bridgwater Canal Acts. Impetus given to canal construction by the Union. Parliamentary Grants. Inland navigation developed by the "Forty-five." The Forth and Clyde Canal. The Crinan Canal. The Monkland, the Aberdeenshire, the Glenkenns, the Glasgow and Paisley, and the Edinburgh and Glasgow Union Canals. The Caledonian Canal, the only British waterway constructed entirely at the cost of the State. Its history. Its dimensions.

THOUGH it began at a much later date, the development of the conservancy of navigation in Ireland

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and Scotland has been carried out more rapidly than, and quite as effectively as, in England and Wales.

The lower portions of the Shannon, Boyne, Bann, and many other Irish rivers, and of the Tay, the Forth, and the Clyde in Scotland, have probably been navigable from time immemorial, and both countries possess an advantage over England in the extent and number of their navigable lakes. The small size and rapidity of the majority of the Scotch rivers is also to some extent counterbalanced, in one part of the country, by the fact that, as pointed out by Mr John Mackintosh in his *History of Civilisation in Scotland*, the basins of the three principal ones in the Lowlands—the Tay, Forth, and Clyde—are not separated from each other by ranges of hills, while the extensive "firths" of the two last-named rivers, penetrating the plain between them on opposite sides, nearly divide the country, the breadth of which is reduced to 50 miles, into two halves.[1] In prehistoric times these natural waterways were probably largely used by the Celtic population both of Scotland and Ireland, who, as mentioned in a former chapter,[2] are known to have possessed both canoes and coracles similar to those of the Britons, and also sea-going boats by means of which communication was kept up between the two countries, and, in the case of Ireland at least, with the nations on the Mediterranean coasts with which trade had been carried on from the earliest times.[3] As in the case of England, however, these early beginnings of trade ceased on

[1] Vol. i., p. 36. [2] *Cf.* Chap. iv., pp. 39, 40.

[3] Mackintosh's *History of Scotland*, p. 70; cf. *A Short History of Ireland from the Earliest Times*, by C. G. Walpole.

the destruction of all commercial enterprise which followed the fall of the Roman Empire; and owing to their greater isolation, the longer period which elapsed before the establishment of settled governments, and their frequently renewed conflicts with England, the advent of commercial and industrial progress in them was necessarily delayed much later than in the case of their wealthier and more powerful rival. At the Restoration, Ireland possessed indeed but little trade or industry, though her natural products, geographical situation, and river system supplied many of the requisites for establishing her as a thriving and industrial nation, as is clearly shown by the increase of her prosperity during the period between the Restoration and the Revolution; which happy condition of things was only checked by the initiation of a long series of measures avowedly intended to restrict her trade and industry. In the seventeenth century her trade was therefore confined to a few of the seacoast towns, and though at one time the exports in corn, flax, hides, and timber assumed considerable proportions, it was throughout hampered and finally extinguished by the jealousy of England.[1] The extent of that in

[1] *Cf.* Walpole's *History of Ireland*, pp. 171-73, and Lingard, vol. ix., p. 67, ed. 1874. The latter describes the legislation employed in 1663 to kill the cattle trade, which at that time amounted to an annual output of more than 60,000 beeves and a proportionate number of sheep. The suppression of the woollen manufacture, carried out at the instigation of an address of the two Houses to "His most sacred majesty" (William III.) is also a palmary instance of the—to put it mildly—commercial "jealousy" of the dominant partner. King William, in his reply to the address, promised that "he would do all that in him lay to discourage the woollen manufacture of Ireland"—and he did. Well may the Dean of St Patrick's declare that "the conveniency of ports and harbours

Scotland during the same period may be estimated by the fact that in 1692 the total number of vessels belonging to the chief ports of the country did not amount to more than 100 with a total tonnage of about 6000 tons;[1] and in both Ireland and Scotland the small amount of manufactures and of internal trade effectively prevented their inhabitants from turning their natural resources to account for the purpose of inland navigation. This delay, however, was so far advantageous that it enabled them, when once in a position to do so, to reap the benefit of the experience which the great engineers by whom our waterways were primarily constructed had gradually gained in England. In Ireland, the conservancy of navigation may, practically speaking, be said to date from the beginning — and in Scotland from the middle of the eighteenth century, and the initiation of river conservancy and that of canal construction were therefore separated by only a short interval in the former, and were almost simultaneous in the latter country. The inland navigation systems of both countries have, moreover, benefited by the fact that the State has taken a more active part, both in management and by financial aid, in their development than in England and Wales, and still exercises a direct control over certain waterways; while that of Ireland differs from those of England and Scotland in being the outcome not of piecemeal legislation but of a comprehensive, though unfortunately

which nature had bestowed so liberally upon this kingdom, is of no more use to us than a beautiful prospect to a man shut up in a dungeon." *Cf.* also *A History of the Commercial and Financial Relations between England and Ireland from the period of the Restoration*, by A. F. Murray, pp. 49-51 *et seq.*

[1] Cf. *History of Civilisation in Scotland*, vol. iv., p. 381.

imperfectly executed scheme, which has been justly described by Mr Coyne, in his *Ireland Industrial and Agricultural*, as one of national importance.

According to the Report of a Committee of the Irish House of Commons presented on 23rd January 1800, proceedings and grants for inland navigation are recorded in the Journals of the House from the year 1703,[1] and in 1715[2] an Act was passed "to encourage the draining and improving the Bogg [*sic*] and unprofitable low grounds, and for easing and despatching the inland carriage and conveyance of goods from one port to another of this kingdom." This statute authorised certain persons named, who are styled the "undertakers," to make the Shannon "portable and passable" for boats, barges, lighters, and other vessels of burthen from the common landing-place of the city of Limerick to the town of Carrick Drumrusk (now Carrick on Shannon) in the county of Leitrim, and appointed members of Parliament and Justices of the Peace for counties adjoining the navigation, Commissioners for adjusting differences arising between the undertakers and riparian proprietors. It also empowered similarly qualified Commissioners in districts drained by the

[1] Cf. *Report of the Commissioners appointed by the Queen to inquire respecting the system of navigation which connects Coleraine, Belfast, and Limerick*, 1882, p. 7. In the first Parliament of Queen Anne 1703, a committee was appointed to prepare a Bill for making the Shannon navigable from Limerick to Jamestown, and reported that the scheme was practical and beneficial, and could be carried out for £20,000. The plan, however, was never adopted, and Bills introduced in 1709 for making the river navigable to Carrick and for the construction of the Newry Canal, proved equally abortive, as did also Petitions for the improvement of the rivers Lim, Bann, and Barrow. See Brewster's *Edinburgh Encyclopædia*, Art. "Navigation Inland," p. 267.

[2] 2 Geo. I.

Liffey, the Rye, the Boyne, the Mungagh, the Brosney, the Barrow, the Glyn, the Bann, the Foyle, the Erne, and in short nearly every river in Ireland "to appoint undertakers to *make and keep navigable the said rivers*, and to open communication between them and adjacent bogs and other lost and useless grounds."

As in the case of many other measures of a similar character, the excellent objects of this Act were defeated by its dependence for execution on private enterprise, and the only navigation constructed under its provisions after the lapse of fourteen years appears to have been the 8 miles of the river Maigue connecting the town of Adare in county Limerick with the Shannon.[1] Another was therefore passed in 1729,[2] which, after reciting the failure of the original Act to accomplish its purpose by reason of "undertakers" not coming forward to execute navigation works on account of the risk and expense incurred in doing so, appointed the Lord Lieutenant, the Lord Chancellor, the four Archbishops, the Speaker of the House of Commons, together with eighty other persons, Commissioners for Ireland to put the said Act into execution, and "for other purposes"—a term including the encouragement of "tillage" and the employment of the poor on "works of public benefit." Despite their number and importance, however, these new Commissioners were as unsuccessful as their predecessors in carrying out the original scheme for the improvement of inland navigation. They appear to have expended "divers sums of money" in carrying out "several useful and necessary works," but these seem to

[1] Cf. *Report*, pp. 7-8. [2] 3 Geo. II.

have been chiefly roads and bridges, drainage operations, and embankments; and the only navigation works undertaken during their twenty-two years of office were that connecting Newry with the Upper Bann and Lough Neagh, and the Tyrone navigation connecting Lough Neagh with Coal Island. It was not till another amending Act had been passed in 1751,[1] under which the Commissioners were incorporated under the title of the "Corporation for promoting and carrying on inland navigation in Ireland," that a first step was taken towards the realisation of the scheme embodied in the Act of 1715 by the commencement of the first Irish canal —the Grand Canal from Dublin to Ballinasloe, with branches to various places; the Lagan navigation connecting Belfast with Lough Neagh; the Barrow navigation from Carrick-dexter to Drogheda; and the Shannon navigation from Limerick to the collieries on Lough Allen. Though, however, the Corporation may thus be held to have laid the foundations of the inland navigation system of Ireland, it was unfitted, owing to its character and constitution, to carry on the work it had begun, and in 1787 it was dissolved, and the tillage dues by which it had been supported were disappropriated by 27 Geo. III. c. 30, while all the navigations it had initiated were vested in local corporations created by the same statute, with the exception of the Grand Canal and the Lagan navigation, which had been transferred to companies respectively incorporated in 1772 and 1779. Between 1787 and 1800 the Royal Canal from Dublin to Cloondara on the Shannon was begun by the Royal Canal

[1] 25 Geo. II. c. 10.

Company, and the Foyle navigation from Strabane to the river Foyle by the Marquis of Abercorn, and by the end of the century the total amount paid by the Treasury for purposes of inland navigation was £875,382, of which £351,966 was issued from the produce of tillage duties between 1730 and 1790, and £505,436 under grants of parliamentary letters from 1750 to 1800. The greater part of these grants were, according to the Report of the Committee of the Irish House of Commons above referred to, made after the year 1755 when there appears to have been a surplus of nearly half a million in the Treasury.[1] "The avidity," to quote the Report, "with which public grants were from that time sought after for inland navigations, as well as for other purposes, appears from the Journals of the House—the objects of these grants being as various as the interests and inclinations of the petitioners." Those made in 1757 and ensuing years for inland navigation, together with others for promoting various local improvements, had for their object, as is shown by Miss Murray in her *History of the Commercial and Financial Relations between Great Britain and Ireland*, the using up of the surplus revenue before it passed into the Treasury, and thus leaving the Crown more at the mercy of the Irish Parliament for its supplies. This policy was the not unnatural result of the resentment of

[1] Macpherson gives details of the grants made by the Irish Parliament during the years 1761 and 1763, from which it appears that those with respect to inland navigation and harbour improvement during the former year amounted to over £51,000, and those during the latter year to over £34,000. *Annals of Commerce*, vol. iii., pp. 350-51.

the last-named body at being treated by the Crown as simply an institution for registering the Decrees of the English Privy Council, and the failure of its attempts to dispose of the surpluses of the hereditary revenue in payment of the National Debt without the king's consent, and the expenditure thus incurred was justified, so far as respects waterways, by the fact that their construction offered, prior to the introduction of railways, the best means of developing the resources of the country.[1] Similar advances, amounting to a million and a half sterling, were, as will be shown later on, made by Parliament in the case of Scotland, and Sir Robert Kane, who contrasts them with those made to Ireland, and points out the benefits they had produced in the former country, observes with much force that "they should not be called grants of money but investments of capital with realisation of enormous profits."[2] But the superintendence of a body so numerous as the Corporation, and so little enabled to form a just estimate of the plans submitted to them, was ill calculated to promote with effect the objects of their trusts, and the expenditure of the sums granted not being sufficiently connected with the permanent private interest or capital of individuals, it is much to be regretted that great sums of public money have been lavished without being attended with corresponding advantage to the public.[3] In accordance presumably with the Report of 1800, a new authority was created by an Act of that year,[4] which empowered the Lord Lieutenant to appoint five persons to be Directors of all works relating to

[1] Pp. 179-80. [2] *Industrial Resources of Ireland*, p. 333.
[3] *Report of Committee of* 1800. [4] 40 Geo. III. c. 51.

inland navigation, in whom all navigations and canals managed by local corporations and not private property were vested, and which granted £500,000 for this purpose and for the improvement of the Port of Dublin, to be expended in accordance with their recommendations.[1] Like that of the "Commissioners for Ireland," and the "Corporation for promoting Inland Navigation," the rule of the "Directors of Inland Navigation" lasted a little over thirty years, and in 1831 their powers and duties were transferred to the Board of Works by 2 Will. IV. c. 33, in which they still remain vested.[2] The Irish inland navigation system has been further improved by the adoption by the Board of some valuable suggestions made by the Commission appointed in 1882 to inquire "respecting the system of navigation which connects Coleraine, Belfast, and Limerick," whose Report contains a very full account of its development and of the condition of the various waterways at the time of its publication. In 1886 another Royal Commission was appointed to inquire respecting the drainage of the district traversed by the Barrow and its tributaries; and the recommendations of both these bodies as regards the Shannon, the Barrow, and the Bann were repeated in the First Report of the Royal Commission of 1887 on Irish Public Works, the scope of whose inquiry included—in addition to the subjects of Deep Sea Fishery, and Railway and Tram-

[1] Cf. *Report of the Commissioners appointed to inquire into the system of navigation connecting Coleraine, Belfast, and Limerick*, 1882, pp. 7-19.

[2] For earlier accounts of Irish canals, *cf.* Philips' *History of Inland Navigation*, pp. 562-71.

way Organisation and Extension—the consideration "of the measures required for the improvement or preservation of any necessary facilities for inland navigation, and for the completion and maintenance of arterial drainage in Ireland, especially in the districts of the three rivers above named." The Board of Agriculture and Technical Instruction for Ireland has also recently endeavoured to promote the revival of interest in waterways by the collection and publication in the Banking, Railway, and Canal Statistics issued by it in 1901 of all the information obtainable from the above sources, together with the tables published by the Board of Trade in 1888.

As only some thirty miles of river navigation—the Maigue, constructed under the Act of 1715, and the Newry and the Tyrone constructed under that of 1729—had been completed *prior to*, and the majority of rivers were improved *after* the commencement of the Grand Canal in 1753, inland navigation has been more systematically developed in Ireland than in England and Wales; and, owing to the broader principles on which canal construction has been conducted in the former country, the united length of its four canals—344½ miles—is nearly equal to that of its thirteen river navigations—346¾ miles.[1] Though, moreover, the waterways in possession of or leased to companies and those vested in local trustees constitute, as in England and Wales, two distinct groups, each of these comprises both rivers and canals; and, in addition to this, there is, as has been said, in Ireland a third group of waterways which does not exist in the latter country consisting of rivers and canals under the control of

[1] See *Report of the Commissioners*, 1882, p. 19.

the Commissioners of Public Works. That State action has in no way interfered with private enterprise is, however, evident from the fact that the largest of these three groups is that comprising the rivers and canals in possession of or leased to companies by private individuals, which have a united length of 418½ miles or more than half that of the total mileage—708¼ miles[1] of the whole Irish system of waterways—and includes five river navigations—the Barrow, the Lagan, the Newry, the Suir, and the Foyle—and the three most important canals—the Grand, the Royal, and the Ulster.[2]

Of the rivers of this group, the most important is the Barrow, the works of which—begun in 1758 but not completed till 1812—entailed an outlay between 1803-12, irrespective of previous expenditure, of £149,501,[3] and which were purchased in 1894 by the Grand Canal Company. It is 43 miles long and has a total fall of 169 feet, and is canalised throughout its course from Athy to St Mullin's Lock, passing through a fertile and highly cultivated country, and meeting at its outfall the rivers Nore and Suir, which connect it with New Ross and Waterford; while the towns of Carrick-on-Suir, Clonmel, Inistogue, and Thomastown are accessible to it at one extremity, and the Port of Dublin at the other.

The Newry navigation, which was purchased by

[1] See *Report of the Commissioners*, and *cf.* chap. xi., *post*, pp. 217-21.

[2] Cf. *Report of the Commissioners*, 1882, p. 19.

[3] Cf. *Ireland Industrial and Agricultural*, pp. 117-18; *Report of the Commissioners appointed to inquire respecting the Drainage of the district traversed by the Barrow and its tributaries*, 1886; and *First Report of Royal Commission on Irish Public Works*, 1887, pp. 27-33.

the Newry Navigation and Harbour Trust in 1901,[1] has a total length of 35 miles, the first portion of which, between Warrenpoint and Newry, is a ship canal admitting vessels drawing 15 feet of water, which is connected with the Lower Bann by a barge canal joining it 16½ miles above Portadown and thus carried to Lough Neagh. Its summit-level is 76 feet above sea-level and 28 feet above the Lough, which is also connected with Belfast by the Lagan navigation, 25¾ miles in length, six of which are river and the remainder canal—a work commenced in 1783 but not completed till the end of the century, and which was in 1890 extended by the acquisition of the Ulster Canal. The river Suir, which, as has been stated, flows into the estuary of the Barrow, is 16½ miles, and the Foyle navigation only 4 miles in length. The Royal Canal, though begun, as we have seen, towards the close of the eighteenth century, was not completed until 1882 when £1,400,000 had been expended on it, £359,776 coming out of the public funds. It passes through county Dublin and between counties Kildare and Meath, and then through counties Westmeath and Longford to Tarmonbury, where it joins the Shannon, its total length, including its two branches to Broadstone Harbour and Longford, being 96½ miles, or more than double that of the Barrow, the longest river in this group.[2]

[1] In 1900 the shares, which in 1881 were worth £55, had fallen to £20. *Cf.* as to its construction a paper by Sir J. Rennie in *Proceedings of the Institution of Civil Engineers*, vol. x., p. 277. Macpherson says (vol. iii., p. 346 note) that the navigation was opened in 1761 for lighters and "gabbards," and describes the latter boats as "small vessels of a flat construction fit for coasting and river navigation." *Cf.* also *Industrial Resources of Ireland*, p. 341.

[2] Cf. *Industrial Resources of Ireland*, p. 340.

The Grand Canal, which has ten branches, and is the most extensive waterway in the United Kingdom, is 163¾ miles long, and extends southwards from Dublin to New Ross in Wexford, and westward to the Shannon at Shannon Harbour, where the trade boats of the company tranship into steamers which ply northwards to Athlone through Lough Key to Carrick-on-Shannon, and southwards by Banagher and Portumna from Lough Derg to Killaloe, and thence by the Limerick Canal to Limerick. On the other side of the Shannon the canal runs to Ballinasloe, with branches to the Liffey, Robertstown, Blackwood Reservoir, Monasteverin, St James' Wells, Athy, Mountmellick, Edenderry, and Kilbeggan, the summit-level, 279 feet above sea-level and 169 feet above the Shannon at Shannon Harbour, being near Robertstown about 25 miles from Dublin. Shannon Harbour and Tullamore were, says Mr Coyne, "once centres of great activity, both in the transmission of grain, etc., to Dublin from the counties of Galway and Tipperary, and as the chief stations for passenger boats, which were for many years the chief and favourite means of communication between the central part of Ireland and the metropolis before the introduction, about the year 1810, of well appointed stage coaches, when the service was reduced to six boats daily. The rate of 8 miles an hour, including delays at the locks, was attained by narrow fly boats, which, drawn by four horses at a gallop, plied only by day. A slower passenger and parcel boat travelled night and day at a moderate speed, and the company maintained five hotels for the accommodation of the

travellers."[1] After the introduction of steam-boats the passenger service was extended to Limerick, but it ceased on the opening of the railway system, the company receiving a remission of its debt to the Government of £88,524. With the view of avoiding embankments the canal has been carried at various places for a distance of 28 miles through bog, but, owing to the stimulus given to the peat trade by its vicinity, the cutting away of the bog in several places to a considerable depth on each side has necessitated a large outlay in maintenance. The total capital expenditure on the canal, inclusive of public grants amounting to £321,674, has been estimated at £1,137,680. Owing not improbably, however, to the fact that nearly all the freight is carried in the company's own boats, it has, in spite of having to compete directly with railways over nearly the whole of its course, attained a success which proves that, with good management, canals are capable of yielding fair profits in Ireland, even through districts devoid for the most part of manufacturing centres or mineral products. Commenced, as already stated, by the Commissioners of Inland Navigation, who received grants of public money between 1753 and 1772 to the amount of £70,496, the canal was in the latter year transferred to a company which received grants to the extent of £83,776 (in addition to £18,231 to secure the completion of the Kingsend Docks) between 1772 and 1800. In 1798 the company

[1] *Ireland Industrial and Agricultural*, p. 115. *Cf.* Kane's *Industrial Resources of Ireland*, pp. 340-41, where it is stated that the number of passengers travelling by packet boats on the canal rose from 54,812 in 1833 to 100,695 in 1837; while the tonnage carried increased from 179,173 tons yielding £33,587, 4s. 9½d. in 1827 to 215,910 tons on which £37,557, 7s. 1d. was paid in 1837.

obtained a loan of £27,692 of public money on the opening of the Athy branch of the canal, and a further grant of £138,461 was made, as recommended by the Government and approved by a Committee of the House of Commons, on the terms that the company should raise £46,154 to be applied, along with the £138,461, in payment of their debts. The extension of the canal from the Shannon to Ballinasloe, and the Mountmellick and Kilbeggan branches which were opened in 1830, were subsequently made for the purpose of giving employment to the poor, and £98,524 was advanced to facilitate their execution, but in 1846 the repayment of this sum was commuted by statute for £10,000. By an Act of 1848 the original company called the "Undertakers of the Grand Canal" was re-constituted under the name of the "Grand Canal Company," and in 1894 it acquired the Barrow navigation above described, which joins it at Athy, at the cost of £30,000.[1]

The Ulster Canal, which is 45¾ miles in length and runs from Blackwater town to Lough (Upper) Erne, was made by a company formed in 1826 under 6 Geo. IV. c. 193. The work, which extended over a period of fifteen years, and on which over £200,000 capital, towards which the Government contributed £130,000 by way of loan, was expended, was transferred to the Board of Works in 1865, and again, in 1890, to the Lagan navigation, and is no longer maintained out of imperial taxation.[2]

[1] Cf. *Ireland Industrial and Agricultural; Report of Commission*, 1882; a paper by Mr Healy in vol. xxvi., p. 6, of *Proceedings of the Institution of Civil Engineers;* and *Industrial Resources of Ireland*, p. 340.

[2] *Cf.* as to the Works of the Ulster Canal, a paper by T. Calbourn, in *Proceedings of the Institution of Civil Engineers*, vol. ii., p. 52 ; also *Industrial Resources of Ireland*, p. 341.

The waterways vested in local trustees, the united length of which is only 102½ miles, are the Upper and Lower Bann, the Ballinamore and Ballyconnell Canal, and the Lough Corrib navigation, all of which were constructed by the Board of Works, the works of the Bann River and those of Lough Neagh, with which it is connected, being executed at a cost of £106,175 between 1845 and 1859; while those of the other two waterways, both of which were undertaken in connection with arterial drainage works, were respectively constructed between 1846 and 1859, and between 1848 and 1889. Of these, the Upper Bann, 7½ miles in length, lies below the junction of the river Blackwater with the Ulster Canal, and connects that canal with Lough Neagh; while the Lower Bann—which has a length of 32½ miles, of which 3 miles 12 chains are lake, 26 miles 40 chains river, and the remainder canal—connects Lough Neagh with Coleraine.[1] The Ballinamore and Ballyconnell Canal, which is practically a series of lakes connected by cuts, unites Lough Erne to the Shannon at the town of Leitrim, and has a total length of 38¾ miles. It occupied thirteen years in construction, being completed in 1859 at a total cost of £228,652, of which £130,000 has been repaid by the adjoining counties, and the remaining £98,652

[1] *Cf.*, as to the Bann, *First Report*, *Royal Commission on Irish Public Works*, 1887, pp. 33-38; and *Proceedings of the Institution of Civil Engineers*, vol. iii., p. 253. Lough Neagh, which is connected with the Newry and Lagan navigations (see p. 183 *ante*) also receives the waters of the Blackwater, Upper Bann, and Ballinderry Rivers, and has an estimated area of 100,000 acres. Its coasts are formed by the counties of Derry, Antrim, Tyrone, Armagh, and Down. See Kane's *Industrial Resources of Ireland*, p. 343; and as to the origin of this "the largest glacial sea in the British Isles," cf. *The Physical Geology and Geography of Ireland*, pp. 217-23.

has been a free grant from the Exchequer. Two bodies of trustees, representing respectively navigation and drainage, took over the works in 1860, with taxing powers for the purposes of maintenance, but though most valuable for the purposes of drainage it has proved a failure as a navigation.

Though there is no direct evidence on the point, a similar combination of arterial drainage and navigation works also presumably conduced to the failure of the Lough Corrib navigation, the cost of which was originally intended to be divided between the Government and the district. As, however, the connection of Lough Corrib with Lough Mask, which formed an integral part of the scheme, proved impracticable owing to the existence of subterraneous limestone caverns, the whole of the expense, £102,289, with the exception of £14,883 repaid by the counties, fell on public funds, and the works were ultimately handed over to trustees,[1] who were empowered in 1874[2] to dispose of the property with the consent of the Grand Jury.

The remaining group of waterways—that controlled by the Commissioners of Public Works, whose powers in this respect were conferred on them by 2 Will. IV. c. 33 in 1831—now consists of only four river navigations, which have a united length of 183¼ miles, and until 1890 it also included the Ulster Canal which was, as already stated, transferred in that year to the Lagan navigation. These are the Maigue, the only undertaking carried out under the original Act of 1715, which is 8 miles long and

[1] Pursuant to 19 and 20 Vict. c. 60.

[2] By 37 and 38 Vict. c. 71. As to the failure of this combination, see Mr Vernon Harcourt's remarks, p. 146, note 2 *ante*.

runs from Adare to the Shannon; the Boyne, commenced by the Corporation for the promotion of Inland Navigation, which is 19 miles long and extends from Navan to Drogheda; the Tyrone, 4 miles in length, which connects Coal Island with the Blackwater River near Lough Neagh; and the Shannon, the navigable portion of which, exclusive of its canal branches, is more than four times the length of the other three put together. Despite their small size, the construction of the Tyrone and the Boyne navigations entailed an expenditure in the one case of £25,813, and in the other of £190,000;[1] while the total cost of the works of the Shannon navigation—which until it passed under the control of the Board of Works was divided into the Upper, Middle, and Lower Shannon, respectively controlled by the Directors of Inland Navigation, the Grand Canal Company, and the Limerick Navigation Company—amounted to £683,321, of which £272,789 was defrayed from local, and £410,523 from general taxes.

The importance of the last-named navigation, the conservancy of which is governed by four Acts of which the first was passed in 1835 and the last in 1874,[2] is enhanced by its almost central position between the east and west coasts of Ireland, and by its connection with Dublin by means of the Royal and Grand Canals. Rising in Cuileagh Mountain, co. Cavan, the Shannon, which is the longest river

[1] £75,000 of this amount was expended in the Boyne works prior to 1789, and £85,000 subsequently by the Directors of Inland Navigation, the remaining £30,000 being raised by public subscription.

[2] 5 and 6 Will. IV. c. 67; and 37 and 38 Vict. c. 60. The intermediate Acts were passed in 1839 and 1846.

in the United Kingdom, traverses in its course southwards the counties of Leitrim, Connaught, Leinster, and Munster, forming several large lakes, the principal of which are Lough Allen, Lough Ree, and Lough Derg, and turning westward at Limerick discharges itself into the Atlantic through a large estuary between the counties of Clare and Kerry. Of its total length of 256 miles, 143 miles—from the northern extremity of Lough Allen to Limerick—are navigable in a direct course, and by the addition of two canals—the Boyle branch 9 miles and the Stokesdown branch 6 miles in length—158 miles of river and canal have been rendered available for traffic, of which 129 miles from Killaloe to Leitrim, including the two branches above mentioned, are navigable by large steamers.[1] As in the case of the Grand Canal, packet boats, until the introduction of railways, plied on the 14 miles, partly river and partly canal, between Killaloe and Limerick, the number of passengers conveyed during the year 1836 being 14,600; while goods traffic on the same waterway rose from 28,212 tons paying £1092, 14s. in tolls during 1831, to 36,018 tons paying £1514, 2s. in 1836.[2]

It will be evident from the above sketch that, though the scheme of 1815 was not carried out fully on the lines originally intended, and has suffered in

[1] Cf. *Ireland Industrial and Agricultural*, pp. 73, 77, 95, 335-39; *Report of Commission*, 188?, pp. 9, 10; *First Report Royal Commission on Irish Public Works*, 1887, pp. 22-27; and *The Physical Geography and Geology of Ireland*, 2nd ed., p. 202 *et seq.*

[2] *Cf.* Kane's *Industrial Resources of Ireland*, pp. 335-44.

its execution through the want of a continuous policy of administration, it has nevertheless provided Ireland with an extensive and excellent system of waterways.[1] Owing to the absence of any such scheme, and more especially to the small size and rapidity of most of its rivers, and the physical features of the country, the development of the inland navigation system of Scotland has been carried out under far less favourable conditions; but it has, in spite of these difficulties, been rendered sufficient for the national requirements, and three of the most important canals which it comprises — the Crinan, the Caledonian, and the Forth and Clyde, the first two of which are under government control—are especially noteworthy as engineering works.

Of the five Scotch rivers which have been utilised for purposes of navigation—the Tay, the Tweed, the Clyde, the Dee, and the Forth—the first named, which is the longest in Scotland, is navigable by vessels of 200 tons for 95 of its total length of 110 miles up to Perth, the harbour and docks of which were constructed under an Act obtained in 1834 and were subsequently extended in 1856, though the navigation of its estuary, which is 25 miles in extent, is somewhat impeded by sandbanks. The important port of Dundee, which is one of the chief centres of linen manufacture in Great Britain,

[1] The commodities carried by the Irish canals in 1899 consisted mainly of coals, bricks, timber, sand, turf, oats, flour, and grain, and such agricultural requirements as artificial manures, grass seeds, etc., besides a fair proportion of general cargo. They are, therefore, as pointed out by Mr Coyne, calculated materially to benefit the farmer if their efficiency is maintained. *Ireland Industrial and Agricultural*, p. 95. *Cf.* also pp. 101-4 of *Banking, Railway, and Canal Statistics, Ireland*, 1901.

is situated 12 miles above the confluence of the Firth of Tay with the German Ocean, and owes its prosperity largely to its harbour, the works of which, begun in 1815 and finished in 1877 at a cost of £800,000, extend about 2 miles along the river-banks, the five docks covering an area of 35 acres.[1]

The Tweed, 96 miles long, has no estuary, and is only navigable as far as the old bridge, dating from 1634, at Berwick, which is situated at its mouth; and though the tide flows 7 miles further, and enables barges to proceed a short distance up the river, trade is for the most part limited to the port of that city, which was made a royal borough in the reign of Alexander I., and during the thirteenth century was the commercial capital of Scotland. Though a stone pier for the protection of the harbour was built in 1815, it was not till 1873 that a dock was begun at Tweedmouth, and, though there is a depth of 17 feet at ordinary and of 22 feet at spring-tides, the channel is narrow, and a large bed of rock on the north side of the harbour itself is left dry at low tides.[2]

The Clyde owes its importance as a navigable river to the city of Glasgow, the port of which until 1653, was Irvine in Ayrshire. As early as 1563, however, the municipal authorities of the city combined with those of Renfrew and Dumbarton in

[1] Cf. *Encyclopædia Britannica*; and Groome's *Ordnance Survey of Scotland*, Art. "Perth." The Tay Railway Bridge at Dundee, opened in 1878, and blown down in the following year, was reconstructed in 1881. Among the Acts relating to the Tay may be noted 11 Geo. IV. & 1 Will. IV. c. cxxi.; 12 and 13 Vict. c. xxiii.; and 38 and 39 Vict. c. cl.

[2] *Encyclopædia Britannica*, vol. iii., p. 611; vol. xxiii., p. 673. The Acts relating to Berwick Harbour are 48 Geo. III. c. civ.; 25 and 26 Vict. c. xxxi.; and 35 and 36 Vict. c. ix.

an unsuccessful attempt to remove some sandbanks, a little above the last-named town, and in 1662 they purchased the 13 acres of ground on the south side of the river which are now Port-Glasgow for the purposes of a harbour, and constructed the first graving dock in Scotland. Smeaton in 1740, James Watt in 1769, Rennie in 1799 and 1807, and Telford in 1806 were all employed to report on the project,[1] and in 1759 the great works for improving and dredging the river up to the city were sanctioned by 32 Geo. II. c. 62, which was followed by a series of similar Acts.[2] One of the later of these[3] transferred the charge of these works in 1840 from the magistrates and council of Glasgow, to whom it had been previously entrusted, to the Clyde Trust constituted under the Act, consisting of the Town Council and other officials of Glasgow and ten representative members—a change which has been of special advantage to the trade of Glasgow and the Clyde ports.[4] Though it drains an area of 1145 square miles, and has a length of about 98 miles from its source in the south of Lanarkshire to Dumbarton, where it expands into a deep, wide, and long estuary called the Firth of Clyde extending from Greenock to the sea, the Clyde was formerly a small stream encumbered by shoals, and till 1773 was fordable on foot at Dumbrick Ford more than 12 miles

[1] *Encyclopædia Britannica*, vol. x., p. 640; and cf. *Rise and Progress of the Port of Glasgow*, by Mr Deas, Engineer of the Clyde Trust.

[2] 10 Geo. III. c. 104; 49 Geo. III. c. 74; 6 Geo. IV. c. 117; 3 and 4 Vict. c. 118; 9 and 10 Vict. c. 23, and many others.

[3] 3 and 4 Vict. c. 118.

[4] *Cf.* Clifford's *History of Private Bill Legislation*, vol. i., pp. 9, 474; vol. ii., p. 272.

below Glasgow. By means of dredging, however, aided in the earlier stages of the improvement works by training and regulation, it has been converted into a deep navigable river, capable of giving access to ocean-going vessels of large draught up to Glasgow, where extensive basins and large graving docks have been constructed for their accommodation. During the last forty-nine years, 41,352,800 cubic yards of material have been dredged from the river and the harbour; and whereas in 1738 the Clyde was only 15 inches deep at Glasgow at low water, 18 inches for about 5 miles below Glasgow Bridge, and 2 feet at Erskine and Dumbrick, and the rise of the tide was only 2½ feet, at the present time the bed of the river is practically level from Glasgow to Port-Glasgow affording a depth of from 17 to 20 feet at low water along the whole distance of about 19 miles.[1]

The Dee which drains an area of 700 square miles, is 87⅛ miles in length, but only the small portion of it which has been utilised for the formation of the harbour of Aberdeen—the chief town and seaport of the north of Scotland, which is built on both sides of its entrance to the German Ocean—has been made navigable. One of the earliest improvements of the harbour, which was protected as far back as the fourteenth century by a bulwark rebuilt in 1484, was the removal of a great rock known as Craig Metallen by David Anderson between 1607 and 1610, and before 1661 a ship-building dock had been built at Footdee but the

[1] Cf. *Rivers and Canals*, vol. i., pp. 252-56. *Cf.* also vol. i., p. 314 *et seq.* of *Proceedings Institution of Civil Engineers;* Wheeler's *Tidal Rivers*, pp. 334-43; and *The Clyde from its Source to the Sea*, by W. J. Milton.

navigation was obstructed by a sandbank until the erection, between 1775-81 at a cost of £18,000, of the North Pier, 1200 feet long and from 16 to 30 feet high, in accordance with the plans of Smeaton. This was extended by 900 feet between 1810-16 by Telford, and under an Act of 1868 it has been increased by another 500 feet, between 1874-77, at a cost of £44,000; and a southern breakwater of concrete 1050 feet long and 47 feet high, on which £76,443 was expended, was built between 1870-73, the depth of water on the bar being thus increased from a few feet to 22 or 24 feet at spring and to 17 to 18 feet at neap-tides. A wet dock, termed the Victoria Dock in honour of the Queen's visit to the city in the latter year, was constructed between 1840-48 which is 29 acres in extent with 2053 yards of wharfage, and tide locks of 80 feet wide, the depth of water on the sill at ordinary spring-tides being 21 feet. Between 1869-72 the Dee was diverted southwards by a channel curving a little over a mile and 170 feet wide at its bottom, while the old river bed has been filled up and utilised for the formation of a new graving dock, 524 feet long and 48 feet wide at the floor, and gradually widening to 74 feet at the cope, the length of the floor being 500 feet and the depth of the sill 20 feet. The cost of the construction of the new channel amounted to £51,585, making the total amount expended on harbour improvements between 1810-72 £1,509,638.[1]

[1] Cf. *Encyclopædia Britannica*, vol. i., p. 41; and Groome's *Ordnance Survey Gazetteer of Scotland*, new ed., Arts. "Dee" and "Aberdeen." There are seven Acts relating to the Dee and Aberdeen, of which the first is 50 Geo. III. c. lxx., and one of the last, 50 and 51 Vict. c. lxxiv.

The Forth, owing to the fact that Stirling and Alloa, both of which have excellent harbours, are situated on its upper waters, and Leith, the port of Edinburgh, on its estuary, is, though only about 70 miles in length, perhaps the most important navigable river in Scotland. Like the Thames it is formed by the meeting at Aberfoyle, 80 feet above sea-level, of two parent streams—the Duchray Water and the Avondhu, which rise on Ben Lomond at altitudes of 3000 and 1900 feet and are respectively 14 and 9 miles long, and the latter of which flows through Lochs Chon and Ard. From Aberfoyle the river flows through Stirling to Alloa where it is joined by the Devon and expands into the Firth of Forth, by which it enters the German Ocean. Its windings in the 18½ miles between Aberfoyle and Stirling amount to 39 miles, and those in the 5¾ miles between Stirling and Alloa—the "Links of Forth"—to 12½ miles; while the Firth of Forth, which is 51 miles in length, varies in depth from 3 to 37 fathoms, and in width from ½ mile at Kincardine to 3 miles above Borrowstouness, 1¼ miles at Queensferry, 5 miles between Granton and Burntisland, 17 miles at Prestonpans, and 8½ miles at Elie. The Forth, the upper part of which was surveyed by Watt and Monson in 1767 with the view of extending the navigation to the slate and lime quarries of Avasoll, is navigable by vessels of 100 to 150 tons up to Stirling, which has an extensive coasting and export trade in wool and various manufactured products, and by vessels of 300 tons up to Alloa, in the harbour of which ships can lie beside the quays in 24 feet of water at springs. The tide flows up to a point 42 miles above Stirling, and in 1843 the depth

of the upper river was increased by the prohibition of the practice of the Stirlingshire proprietors of using it for carrying off peat refuse from their land—one of them having floated away over 1000 acres of this substance between 1783 and 1839. The improvement of Leith Harbour was begun, under various Acts of George III., by Rennie in 1801, and since that date upwards of £1,000,000 sterling has been expended on the works, which comprise five docks with an aggregate area of 43 acres, seven graving docks, and two piers which are respectively 1177 and 1041 yards long. In addition to some thirteen tributaries, of which the Teith, Allan Water, Devon, Avon, Esk, Almond, Water of Leith, and Carron Rivers are the most important, the Forth is connected with the Borrowstounness Canal at the town of that name, and the Forth and Clyde Canal at Grangemouth.[1]

The Clyde Improvement Act of 1759 which has so largely contributed to the prosperity of Glasgow was passed in the same year as the latter of the two Acts sanctioning the construction of the Bridgwater Canal which has played a similar part in the progress of Manchester. It was natural therefore, having regard to the great impetus given to Scottish trade by the Union with England in 1707, that the success of the latter undertaking should have led to the initiation of numerous similar enterprises in Scotland, some of which, as in England, never advanced beyond the preliminary survey, or after being completed and used for many years have been extinguished by

[1] *Cf.* Chambers's *Encyclopædia*, Arts. "Forth," "Alloa," "Stirling," and "Leith"; and Rees' *Cyclopædia*, Art. "Canal." One of the most important recent Acts relating to the river is 36 and 37 Vict. c. xlvii.

railway competition, but the principal of which are still in full working order.

As in the case of the Irish waterways, various grants were made by Parliament in aid of the construction of the more important Scotch canals; and it may be noted as a curious illustration of the proverb "it is an ill wind which blows nobody good," that these grants were in many cases made out of the income derived by the Crown from the forfeited estates of the adherents of the Pretender in the Rebellion of 1745, which may thus be said to have indirectly contributed to the development of inland navigation in Scotland.[1] The management of these estates was, by an Act of 1752 annexing them to the Crown, vested in a Board which was empowered to "apply the rents and profits to the better utilising and improving the Highlands of Scotland,"[2] and which amongst other proposals for promoting this object, recommended in 1773 the construction of 32 miles of canal for connecting the Tay at Perth with Loch Earn, on the shores of which were valuable limestone quarries. This project was eventually abandoned on account of the dissolution of the Board, and, though revived in 1806 by a Committee on the application of the Forfeited Estates' Funds, who recommended a grant of £4500 for the purpose, and successively approved both by James Watt and Rennie, was never carried out.[3] A subse-

[1] It has been shown that the development of Irish waterways in the middle of the eighteenth century was indirectly furthered by the policy of "passive resistance" adopted by the Irish Parliament towards the Crown in consequence of the restrictions imposed upon it by the English Government, and it is curious to note that the waterways of Scotland derived a similar indirect benefit from one of "active resistance."

[2] 25 Geo. II. c. 41.

[3] *Report of the Committee*, pp. 22-24.

quent Act of 1784,[1] however, which repealed that of 1752, and vested the management of the Forfeited Estates which it granted under certain conditions to the heirs of the proprietors, in a new Board of Trustees, authorised an advance of £50,000 to the Forth and Clyde Navigation Company; and under Acts of 1803[2] and 1806[3] sanctioning the application of the Forfeited Estates' Funds for the construction of roads, bridges, canals, harbours, and other public works, £25,000 was advanced for the completion of the Crinan Canal, £25,000 for the improvement of Leith Harbour, and £20,000 for the preliminary expenses of the Caledonian Canal, the whole of the subsequent cost of which, amounting to £1,280,000, was entirely defrayed by Government.

The earliest and perhaps most successful of the Scotch canals is the Forth and Clyde, which runs almost parallel with the Roman Wall of Antoninus between Grangemouth on the former and Bowley on the latter river, and provides a waterway between the east and west coasts navigable by vessels of 19 feet beam and 68 feet keel. It appears to have been one of the numerous unattempted projects for the development of inland navigation originated in the reign of Charles II., and the scheme was revived soon after the Union. Surveys for carrying it out, which however had no further result, were first made by Mr Gordon in 1723, and in 1726, at the instance of Lord Napier, by Mr Maskell, the intended route in the latter case being from Yocker Burn on the Clyde, 5 miles below Glasgow, to the Forth about 2 miles from the mouth of the Carron River. Mr

[1] 24 Geo. III. c. 57, sect. 26. [2] 43 Geo. III. c. 80.
[3] 46 Geo. III. c. 155.

Maskell's report led the Board of Trustees for the Encouragement of Fisheries in Scotland to employ Smeaton to make a third survey in 1764, and though that body abandoned the idea of constructing the canal on the ground that the trade was not sufficient in amount to meet the outlay necessitated by his estimates, it was eventually begun by him in 1768 and completed by Whitworth in 1790 at a cost of £150,000. There are thirty-nine locks on the canal, which has a rise of 156 feet from the sea to the summit-level, and crosses the Kelvin—the bridge over which is 275 feet long and 65 feet high—and the Luggie rivers, as well as several rivulets and roads, and has a total length, inclusive of a branch of 3½ miles to Port Dundas a few miles below Glasgow, of 33¼ miles and a depth of 8 feet.[1]

In 1793 an Act which Philips, a contemporary writer, describes as "one of the most useful for the fisheries of Scotland ever passed,"[2] was obtained for the formation of the Crinan Canal, of which John, Duke of Argyll, was one of the promoters, and which was the first canal projected by Rennie. This important waterway, which runs from Lough Gilp in Argyllshire to the Sound of Jura, provided a short cut of about 9 miles, navigated by means of fifteen locks, for the trade of the Western Islands and fisheries in lieu of the long and dangerous voyage round the Mull of Cantire, and has a breadth at the surface of 66 feet and at the bottom of 13 feet, and is

[1] *Cf.* Philips' *History of Inland Navigation*, p. 50 *et seq.; Lives of the Engineers*, vol. ii., pp. 55-59; *History of Civilisation in Scotland*, vol. iv., p. 376; *Proceedings of the Institution of Civil Engineers*, vol. xxvi., p. 10; *Encyclop. Britann.*, vol. xxi., p. 500; Wheeler's *Tidal Rivers*, p. 342.

[2] 39 Geo. III. c. xxvii. *Cf.* Philips, p. 552.

navigable by vessels drawing 12 feet of water. It was completed in 1801 at a total cost of £100,000, and in 1848 was vested by 11 and 12 Vict. c. 54 in the Commissioners of the Caledonian Canal.[1]

Among the lesser canals one of the earliest was the Monkland, 11½ miles in length, connecting Glasgow with the Monkland mineral district, and united by the branch above mentioned with the Forth and Clyde Canal at Port Dundas, which was completed in 1791.[2] This was followed by the construction under Acts of 1796 and 1801, at a cost of £20,000, of the Aberdeenshire or Don and Dee Canal, 19 miles long, from the Don near Inverurie through various parishes on the south side of the river to Aberdeen Harbour; and, under an Act of 1802, authorising an expenditure of £30,000, of the Glenkenns Canal, 27 miles long, from Dalry along the east side of the Ken and Dee to the tideway of the latter river which is navigable up to Farland 2½ miles above Kirkcudbright—the best harbour as regards accessibility, spaciousness, and shelter on the south coast.[3] In 1807 a canal, originally intended to

[1] *Cf.* Philips, pp. 547-49, 551; *Annals of Navigation*, vol. iv., pp. 253-64; *Encyclop. Britann.*, vol. ii., p. 500; Rees' *Cyclopædia*, vol. vi., Art. "Canal"; and Brewster's *Edinburgh Encyclopædia*, vol. xv., Part I., p. 267.

[2] Cf. *Encyclop. Britann.*, vol. xxi., p. 560; Brewster's *Edinburgh Encyclopædia*, vol. xv., Part I., p. 264.

[3] *Cf.* Philips, pp. 549, 552; Macpherson's *Annals*, vol. iv., App. iv.; Brewster's *Edinburgh Encyclopædia*, vol. xv., Part I., p. 265; and Priestley's *History of Inland Navigation*, pp. 2, 4, and 309. Kirkcudbright Harbour comprises all the reach of the Dee from the sea to the town and estuary over a length of 6 miles; but, owing to the rapid recession of the Solway tides, it is dry at low water, and therefore only suitable to small vessels, though ships can lie at anchor in 16 feet at low and 40 feet at high water. *Cf.* Groome's *Ordnance Gazetteer of Scotland.*

connect Glasgow with Paisley and Ardrossan on the Firth of Clyde, was begun, which is 30 feet broad at the top and 18 feet at the bottom with a depth of 4½ feet, but, owing presumably to want of funds, only a length of 12 miles between Glasgow and the town of Johnston beyond Paisley was made. The Edinburgh and Glasgow Union or, as it is now termed, the Union Canal, from Port Hopetoun in Edinburgh to the Forth and Clyde Canal at Camelon, Falkirk, which was projected as early as 1796, was begun in 1818 and finished in 1822 at a cost of £400,000, which was increased by an additional £600,000 within four years of that date—an expenditure partly perhaps due to the fact that, though the distance between its termini in a straight line is only 25 miles, its actual length is 31½ miles owing to the deviations in its course made in order to maintain a dead level and avoid locks.[1] The same year 1822 also witnessed the opening of the Caledonian Canal, begun eighteen years earlier, which extends diagonally across Scotland from the Atlantic to the North Sea, and is noteworthy, not only as one of the finest monuments of the genius of Telford and one of the most remarkable engineering works in the United Kingdom, but also as the only British waterway which has been constructed entirely at the cost of and has always remained under the control of the State.[2]

[1] Cf. *History of Civilisation in Scotland*, vol. iv., p. 379; *Encyclop. Britann.*, vol. xxi., p. 530; Brewster's *Edinburgh Encyclopædia*, vol. xv., Part I., p. 264; Groome's *Ordnance Gazetteer*, Art. "Union Canal."

[2] It will have been observed that the Irish waterways have all been constructed partly by State aid and partly by private enterprise, and have passed often from the control of the Government to that of a company.

The first survey of the route for the canal from Fort William to the Moray Firth—as Philips, who wrote when the scheme was beginning to assume practical shape, terms the Caledonian Canal[1]—was made in 1773 by Telford's friend James Watt. whose descriptions are frequently referred to by the former in his report. It was again surveyed in 1793 by Rennie, who agreed with Watt in regarding the project as practicable, but no attempt was made to give effect to their views until 1801, when the war with Napoleon led to the revival of the scheme in conjunction with various other proposals for the construction of ship canals between suitable points on the eastern and western coasts—such as Portsmouth and London, and the English and Bristol Channels[2]—for providing shelter for British shipping from French privateers. As the locks which occupy a large portion of the Great Glen were sufficiently deep to allow of their navigability by large vessels, the proposed Caledonian Canal appeared to be eminently suitable for a through route of this description, and also offered the additional advantages of enabling merchantmen and fishing boats to avoid the dangers and delays incident to the 500 miles voyage by the Orkneys and Cape Wrath,[3] and ships of war to reach the north of Ireland from a naval station in the Moray Firth or on the adjacent Scottish coast in two or three days. For these reasons the project was included in a general scheme for improving the

[1] *History of Inland Navigation*, 4th ed., pp. 556-62.

[2] The latter scheme was reported on by Telford in conjunction with Captain Nicholls in 1825.

[3] These delays sometimes lasted between three and four months, Cf. *Lives of the Engineers*, vol. ii., pp. 409-10.

condition and checking the excessive emigration of the population of the central Highlands and sea-coasts, into the practicability of which Telford was appointed by the Commissioners of the Treasury to inquire in 1802, and which also comprised the construction of roads and bridges, the development of fisheries, and the improvement of communication with Ireland. In accordance with these instructions, Telford made a survey of the route for the canal, in which he was accompanied by Jessop as consulting engineer, and also obtained a number of unanimously favourable opinions with respect to its utility from leading merchants and shipowners in Leith, Aberdeen, and Peterhead on the east, and Greenock, Dublin, Liverpool, and Bristol on the west coast, as well as from the Highland Society[1] which had supplied the Government with detailed information respecting public works calculated to diminish emigration during 1801-3. His report advocating its construction, and the adoption of the other remedial measures above mentioned, was referred by the Treasury to a Select Committee of the House of Commons, on the recommendation of which an Act was passed in 1803 (43 Geo. III. c. 102) incorporating the Caledonian Canal Commissioners and "granting to His Majesty the sum of £30,000 towards defraying the expense of making an inland navigation from the eastern to the western sea by Inverness and Fort William"; while by another statute of the same year a separate Board was appointed for constructing and improving harbours

[1] It may be noted that the Highland Society, which was instituted in 1794, had itself received a grant of £30,000 from the Forfeited Estates Commissioners.

and making bridges and roads.[1] The canal was begun in 1804, but, owing to the difficult character of the country, and to the fact that the works were designed on a scale sufficient to allow of the passage throughout its course of a fully equipped thirty-two gun frigate laden with stores, and included docks at its two extremities, one of which, at Clacknagarry, had an area of over 32 acres, it was not completed till 1822 when its total cost amounted to nearly double Telford's original estimate of £500,000. It appears, however, to have been even then not quite in working order, and as, greatly to Telford's disappointment, it was at first very much less used than had been anticipated, the works had fallen considerably into decay by 1837 when the Government, which had for a time contemplated closing it, were induced by the Report of Mr James Walker, who made a survey of the canal in 1837, to expend an additional £300,000[2] in carrying out his recommendations for its improvements which necessitated the suspension of traffic for ten years. It was reopened in 1847, nearly three quarters of a century after the first survey by James Watt, and in the following year the Crinan Canal was united with it and vested in the Caledonian Canal Commissioners by an Act (11 and 12 Vict. c. 54) which also newly incorporated that body, whose powers had in the interim been extended by 44 Geo. III. c. 62 and subsequent Acts.

The length of the canal from its southernmost

[1] Twelve hundred new bridges and 920 miles of road were constructed by the Board by 1820.

[2] Mr Stevenson, in his article on the canal in the *Encyclop. Britann.*, vol. iv., p. 788, gives the total cost as £1,300,000; while Smiles' *Lives of the Engineers*, vol. ii., p. 417, places it at £1,200,000.

extremity at Corpach at the head of Loch Eil opposite to Fort William to its north-eastern terminus at Clacknagarry on the shore of Beauly Firth is 60 miles, of which 37½ consist of four naturally navigable freshwater lochs which are connected by a series of canals with a united length of 23 miles—Loch Lochy on the south; Lochs Oich and Ness, the areas of which are 2 square miles and 32 square miles respectively, and Loch Dochfour, which is much smaller in extent, on the north. There are docks both at Corpach and at Clacknagarry, the latter of which are about 976 yards long and upwards of 162 yards wide and cover an area of about 32 acres. From these points on the western and eastern seas the navigation is carried to the summit-level at Loch Oich, the surface of which is 100 feet above high water mark at Inverness and Fort William, by twenty-eight locks[1] of which that at the entrance to the canal at Clacknagarry, and a second lock giving access to a spacious artificial harbour at Muirtown, are each 170 feet long and 40 feet wide and have a lift of about 8 feet. At the south end of this harbour are four connected locks 170 feet long and 40 feet wide with a rise of 32 feet which carry the canal to the level of Loch Ness, which it enters at Boma, and thence by seven locks to Loch Oich, at the north-eastern end of which is a regulating lock. By means of this lock, and of two more between it and Loch Lochy and of another regulating lock at its southern end, the canal is continued on the level of Loch Lochy to Bannavie which is within a quarter of a mile of the sea. From this point it descends 64 feet

[1] *Lives of the Engineers*, vol. ii., p. 414. Mr Stevenson in the article above referred to describes only twenty-six of these.

by means of eight connected locks—called by Telford "Neptune's Staircase"—constructed to overcome the difficulty caused by the difference in level between Lochs Lochy and Eil, which, though the distance is only 18 miles, amounts to 90 feet; and it is finally carried down by means of two additional locks to the great entrance or sea lock at Corpach. The connecting canals are 120 feet wide at the top water-level and 50 feet at the bottom and 20 feet in depth; but it has been estimated by Mr Stevenson[1] who reported to the Admiralty on the canal in 1849 in conjunction with Mr James Veitch, R.E., that the standard depth of the waterway taken as a whole cannot be regarded as more than 18 feet, which, however, renders it navigable by vessels of 160 feet in length, 38 feet in beam, and 17 feet in draught. Though, owing to the increased size of such vessels, it can no longer be utilised, as originally intended by large merchantmen and ships of war, the Caledonian Canal, while it still continues to facilitate the passage of fishing boats between the east and west coasts, has also proved very beneficial for purposes of local trade by vessels of between 500 and 600 tons.[2] The ninety-ninth Report of the Commissioners shows that

[1] Cf. *Report on the Caledonian Canal to the Admiralty in* 1849, by James Veitch, R.E., and David Stevenson.

[2] Cf. *A survey and Report of the coasts and Central Highlands of Scotland made by command of the Rt. Hon. Commissioners of H.M. Treasury in the autumn of* 1802, by Thos. Telford, C.E., pp. 3, 12, 14, 16, 17, 25, 26, and App. p. 21; *Lives of the Engineers*, vol. ii., pp. 409-417; Article by David Stevenson on "Caledonian Canal," *Encyclop. Britann.* Brewster's *Edinburgh Encyclopædia*, Art. "Navigation Inland," vol. iv., pp. 787, *et seq.*, vol. xv., Part I., p. 265; Chambers's *Encyclopædia*, Ed. 1903, Art. "Caledonian Canal"; and *Proceedings of the Institution of Civil Engineers*, vol. i., p. 42, vol. ii., p. 149, and vol. xiv., p. 39.

the receipts on the working of the canal during the year 1904 amounted to £7746, 11s. 4d., the expenditure to £7284, 4s., and the balance due to them by the Bank of Scotland to £6639, 16s. 3d. as against £6177, 8s. 11d. on 30th April 1903, while the receipts derived from the Crinan Canal, the revenue from which has been continuously increasing since 1902, amounted to £6370, 3s. 9d., the expenditure to £6030, 12s. 2d., and the balance with the Bank of Scotland to £2810, 17s. 5d. as against £2471, 8s. 3d. in the previous year.[1]

[1] *Report*, pp. 3, 4.

CHAPTER XI

OUR WATERWAYS IN THE TWENTIETH CENTURY

Extent and distribution of the system. Absence of information with respect to many waterways available for navigation. No official record with respect to waterways abandoned or converted into railways. Discrepancy between estimates of the Board of Trade and those of various experts. Lists of waterways by Mr Taunton, Mr Lloyd, and Mr Wells, a valuable supplement to that of the Board. Omissions with respect to Ireland supplied by Report of Lord Monck's Commission. Inadequate data with respect to Scotland. Analysis of estimates. Railway and canal competition. Advantageous position of canal companies at its commencement. Canal companies carried away by railway mania put pressure on railway companies to take over their undertakings. Rapid acquisition of canals by railway companies. Modes of acquisition. Comparison between the extent and financial condition of the two systems. Their progress determined by the policy of the Legislature. Neglect of Parliament to adopt recommendations of numerous commissions and committees with respect to the regulation of competition. Early Railway and Canal Traffic Acts. The Canal Boats Acts. The Railway and Canal Traffic Act 1888. Results of legislation. Effect of railway control on inland navigation system. Internal defects of system. Faulty construction and imperfect condition. Want of enterprise among canal companies. No "canal interest." Causes of success of the railway movement. Number of competing companies and conflicting authorities on through routes by water. Contrast between the carrying trade on railways and canals. Comparative profits of canal companies as toll takers and as carriers. Want of a "clearing" system corresponding to that of railway companies for canal companies. Necessity for a policy of co-operation instead of the existing competition between canal companies. Revival of inland navigation a remedy for checking railway monopoly. The burden of railway transportation charges.

It has been shown in the foregoing survey of its history that the development of inland navigation

in England and Wales, from the passing of the earliest Act for removing obstructions in the Thames, in 1423,[1] to the completion of the Manchester Ship Canal in 1885, extended over more than four and a half centuries; that in Ireland, where it began in 1715 with the improvement of the Maigue river, and ended with the completion of the Ballinamore and Ballyconnell Canal in 1859, it occupied little more than a third of that period; and that in Scotland it was limited to the eighty-eight years between the passing of the first Clyde Improvement Act in 1759 and the completion of the Caledonian Canal in 1847. It is now proposed to examine the extent and condition of the system of waterways in the United Kingdom established by this process of development and briefly to consider the question of its future maintenance and improvement.

Roughly speaking, this system may be said to have originally comprised some *sixty-nine* rivers and *eighty-six* canals in England and Wales, *twelve* rivers and *four* canals in Ireland, and *five* rivers and *eight* canals in Scotland, or a total of *eighty-six* rivers and *one hundred and eight* canals; but as there are, as was pointed out by the late Mr Conder in his evidence before the Select Committee on Canals, 1883,[2] many waterways of which no record has been preserved, as for example, Milford Haven, which is one of our finest harbours and has between 20 and 30 miles of inland navigation—this total must be taken as only approximately correct. On the

[1] 2 Hen. VI. c. 9.

[2] *Report*, p. 121, Qu. 2365; and App. x., p. 232.

other hand, several canals and river navigations of which no mention is made in official records have either been abandoned or converted into railways since the introduction of the latter system; and, though estimates of the mileage of the inland navigation system of the United Kingdom have been made by various eminent engineers which largely supply the omissions in the official statements, the difference in the results arrived at make it somewhat difficult to determine its precise extent.

An estimate of the Board of Trade embodied in a statement presented by the Assistant Secretary, Mr Calcraft, to the Select Committee on Canals of 1883, which was, however, based on a Return to the House of Commons of 1870 subsequently found to contain many inaccuracies,[1] makes the length of the English and Welsh waterways 2688 miles, that of the Scotch 85 miles, and that of the Irish 256 miles, making a total of 3092 miles;[2] but these totals have been now corrected in a Return issued by the Board in 1898, in which the mileage for England and Wales is stated to be 3167 miles 16¼ chains, that for Scotland 153 miles 21 chains, and that for Ireland 586 miles 32 chains—a total of 3906 miles 69¼ chains.[3] This total, however, is considerably below that arrived at by Mr Conder, who, in his evidence before the Committee of 1883, estimated the total mileage of the waterways of the United Kingdom

[1] See evidence of Mr Conder, *Report Select Committee on Canals*, 1883, p. 120, Qu. 2362-65.

[2] *Report*, App. iii., pp. 214-16.

[3] P. 5.

—inclusive presumably of such as are derelict or converted into railways—as 5461 miles, comprising 4333 miles in England and Wales, exclusive of 1875 miles of non-navigable rivers which act as feeders; 354 miles in Scotland; and 755 miles in Ireland.[1] Mr Conder's estimate, again, is considerably in excess of those respectively submitted to the same committee by Mr Taunton and Mr Lloyd, the former of which states the mileage for England and Wales as 2822 miles inclusive of 371 miles now abandoned or converted into railway, and that for Scotland as 190 miles, but gives no details as to Ireland;[2] while the latter, which is limited to England and Wales, makes the total mileage 4050 miles, of which 308 are abandoned or converted into railway.[3] These two estimates in their turn differ scarcely less both from that of Mr Wells, who, in the list appended to the excellent map which accompanied his paper on "Canals" read at the Birmingham Conference on Inland Navigation in 1895, gives the total mileage of the English and Welsh waterways as 3935 miles, of which 415 miles are derelict or converted into railway;[4] and also from that of Mr Vernon Harcourt in a paper read before the Society of Arts in 1899,[5] where the total mileage for the United Kingdom—exclusive presumably of waterways which have been abandoned or converted into railway—is stated as 4106 miles, comprising 3374 miles in England and Wales, 122

[1] *Report*, p. 120.
[2] *Report*, App. viii., pp. 225-28.
[3] *Report*, App. ii., pp. 206-09.
[4] *Report of Proceedings*, p. 28, ref. map.
[5] *Journal*, vol. xlvii., p. 153 *et seq.*

miles in Scotland, and 610 miles in Ireland.[1] In addition to this, none of the estimates with respect to Scotland, apparently, include the navigable portions of the Tay, Forth, Clyde, Dee, and Tweed, which have a combined mileage of 188 miles; nor do they record the number of Scotch waterways which have been abandoned or converted into railway, though it may perhaps be assumed from their omission from the Board of Trade Return of 1898 that the Aberdeenshire, Glenkenns, and Glasgow and Paisley Canals, which have a combined mileage of 58 miles, are no longer available for traffic. Lastly, the estimates of the Board of Trade and

[1] In the subjoined table these various estimates are given in order of date:—

	Board of Trade, 1883.	Mr Conder, 1883.	Mr Taunton, 1883. England, Wales, and Scotland only.
	Miles.	Miles.	Miles.
England and Wales	2688	4333 1878 feeders	2451 371 derelict
Scotland	85	354	190
Ireland	256	755	...
Total	3029	7320	3012

	Mr Lloyd, 1883. England and Wales.	Mr Wells, 1895. England and Wales.	Board of Trade, 1898.		Mr V. Harcourt, 1899.
	Miles.	Miles.	Mls.	Ch.	Miles.
England and Wales	3742 308 derelict	3920 415 derelict	3167	16¼	3374
Scotland	...	...	153	21	120
Ireland	...	...	586	32	610
Total	4050	4335	3906	69¼	4106

of Mr Vernon Harcourt with respect to the mileage of the Irish waterways are respectively 123 miles and 89 miles below, while that of Mr Conder is 47 miles in excess of the total of 708 miles 20 chains given in the Report of Lord Monck's Commission, which however, includes two derelict waterways—the Ballinamore and Ballyconnell Canal, and the Lough Corrib navigation, which have a combined mileage of 62 miles.

Greatly, however, as these estimates differ, their discrepancy appears to be mainly due to the omission from some of waterways included in others, and does not, with a few trifling exceptions, extend to actual mileage; and, though those of Mr Conder and of Mr Vernon Harcourt do not furnish any details which can be used for this purpose, the lists compiled by Mr Taunton, Mr Lloyd, and Mr Wells, and, as regards Ireland, that contained in the Report of Lord Monck's Commission, thus constitute a valuable supplement to the Board of Trade Return of 1898 which embodies the latest information on the subject supplied by conservancy boards and canal companies. It will be found on comparing them that this Return omits various waterways still available for traffic which are given in one or more of the other authorities, and the mileage of which amounts in England and Wales to 626 miles 44 chains, in Scotland to 188 miles, and in Ireland to 43 miles 27 chains—a total of 857 miles 71 chains, which, when added to the official estimate of 3906 miles 69¼ chains, makes the actual mileage for the United Kingdom 4764 miles 60¼ chains. As the waterways in the United Kingdom which have been abandoned or converted into railway have a combined

mileage of 607 miles 68 chains, of which 487 miles 42 chains are in England and Wales, 58 miles in Scotland, and 62 miles 26 chains in Ireland, the total extent of the inland navigation system of the United Kingdom as originally constructed may be assumed to have been 5372 miles 48¼ chains—an estimate, it may be noted, which, if we deduct from his total of 7320 miles the 1878 miles of non-navigable rivers acting as feeders, is only about 70 miles less than that of the late Mr Conder. An analysis of the various estimates alluded to is exhibited in the subjoined table :—

	Board of Trade Return, 1898.		Additions from Lists of Messrs Taunton, Lloyd, and Wells.		Total of Waterways available for Traffic.		Waterways abandoned or converted.		Total Waterways originally constructed.	
	Mls.	Ch.	Mls.	Ch.	Mls.	Ch.	Mls.	Ch.	Mls.	Ch.
England and Wales	3167	16¼	626	44	3793	60¼	487	42	4281	22¼
Scotland . .	153	21	188	...	341	21	58	...	399	21
Ireland . .	586	32	43	27	629	59	62	26	692	5
United Kingdom	3906	69¼	857	71	4764	60¼	607	68	5372	48¼

The waterways of England and Wales are divisible into six groups, one of which has its centre in Birmingham, while the remaining five either wholly or partially unite in the estuaries of the Humber, Mersey, Wash, Thames, and Severn.[1] The two last-named rivers are connected with each other and with the Mersey—according to an estimate of the late Mr Conder—by 648 miles of waterway, the Thames and Humber by 537 miles, the Severn and

[1] *Cf.* Mr Wells' paper on "Canals," *Proceedings of Birmingham Conference on Inland Navigation*, p. 29.

Mersey by 832 miles, and the Mersey and Humber by 680 miles, while the Fen waters flowing into the Wash have an extent of 431 miles;[1] and these waterways furnish nineteen different through routes between London and the manufacturing districts and the principal ports. Thus, London is connected with Liverpool by *three*, with Hull by *two*, and with the Severn Ports by *four* routes; Liverpool with the Severn Ports by *two*, with Hull by *three*, and with the South Staffordshire mineral districts by *two* routes; and the South Staffordshire mineral districts with the Severn Ports by *three* routes;[2] but, though *nine* of these through routes terminate in the Severn Ports and *nine* in London as against *ten* in Liverpool and *five* in Hull, the waterways of the midland and northern have now become of far greater importance than those of the southern counties. The total traffic on the English and Welsh waterways in 1898, according to the Board of Trade Return of that year, amounted to 37,426,886 tons, and it is estimated by Mr Vernon Harcourt that 23,500,000 tons of this is concentrated round the mining and manufacturing centres of an area bounded by the Birmingham and Shropshire Union Canals, the Leeds and Liverpool Canal, the Aire and Calder navigation, the Don navigation, a line from Sheffield to Stoke, and the Trent and Mersey navigation, the united length of the waterways of which amounts to only 624 miles.[3] While the traffic of the Birmingham canals amounts to 7,750,000

[1] Cf. *Report, Select Committee on Canals*, 1883, p. 120 *et seq.*

[2] *Ibid.*, App. p. 210, and *cf.* Mr Abernethy's map, App. p. 205, and that of Mr Wells.

[3] *Journal of Society of Arts*, vol. xlvii., No. 2, 409, pp. 164-65.

tons, that of *three* other systems of waterways within this area to between 2,000,000 and 3,000,000 tons, that of *three* to between 1,000,000 and 2,000,000 tons, that of *seven* to between 500,000 and 1,000,000 tons, and only *three* have less than 500,000 and none less than 100,000 tons traffic, the Grand Junction Canal is the only waterway extending into the southern counties with a traffic exceeding 1,000,000 tons, and only *three*—the Stafford and Worcester Canal, the river Lea, and the Thames between Oxford and London—have a traffic exceeding 500,000 tons.[1]

In Scotland, where the total traffic in 1898 was 1,223,304 tons, the only waterways having a traffic exceeding 100,000 tons are the Forth and Clyde navigation, on which it amounts to about 1,250,000 tons, and the Edinburgh and Glasgow Union Canals, on which it is about 130,000 tons;[2] and in Ireland 309,288 tons or nearly half of the total traffic on its waterways, which in 1898 amounted to 708,174¼ tons, is concentrated on the Grand Canal, which, with the Lagan Canal, with a traffic of 171,784 tons, are the only two on which the traffic exceeds 100,000 tons, while the Shannon, with 83,688 tons, is the only waterway on which it exceeds 50,000 tons.[3]

Despite their defective condition and the vastly superior facilities provided by railways, the total traffic on the waterways of the United Kingdom in 1898, inclusive of 1,142,447 tons passing free of toll on the Manchester Ship Canal, was 40,500,871¼

[1] *Journal of Society of Arts*, vol. xlvii., pp. 163-5, and cf. *Board of Trade Return*, 1898, pp. 82-108 and 114-23.

[2] *Ibid.*, vol. xlvii., p. 163; and cf. *Board of Trade Return*, p. 189, and pp. 5, 108, 110, 124.

[3] *Board of Trade Return*, pp. 5, 110, 112, 124.

tons, more than nineteen-twentieths of which were carried on those of England and Wales.[1] This is indeed only one-seventh of the goods traffic carried by its railways in 1897 which amounted to 315,876,500 tons; but, as is pointed out by Mr Vernon Harcourt in the paper already alluded to, the fact that it is still so considerable, "furnishes some indication of the very flourishing condition inland navigation would have attained in the mining and manufacturing districts of England if anything like the energy displayed in railway extension had been devoted to making the old waterways suitable to modern requirements."[2] Having regard, however, to the fact that canals—which from the financial point of view constitute the most important portion of our inland navigation system—have, like railways and other similar undertakings originating in private enterprise, been always primarily considered as pecuniary speculations rather than works of public utility, their premature abandonment, much as it is to be regretted, is in no way surprising. As their remarkable development during the eighteenth century was mainly due to the discovery by the public that money might be made out of them, the withdrawal of a large part of the capital on which their maintenance depended became inevitable when it began to be realised, after the completion of the railway from London to Birmingham in 1838, that railways offered a more remunerative investment.

In his evidence before the Select Committee on

[1] Cf. *Board of Trade Return*, 1898, pp. 112, 124.

[2] *Journal of Society of Arts*, vol. xlvii., p. 166; and *cf.* Mr Wells' paper on "Canals." *Proceedings of the Birmingham Conference*, 1895, p 33.

Canals 1883 the late Mr Conder, who was one of the ablest and most energetic advocates of inland navigation, described the railway companies as having "been enabled, in some cases by means of very questionable legality, to obtain command of 1717 miles of canal, so adroitly selected as to strangle the whole of the inland water traffic, which has thus been forced upon the railways to the great interruption of their legitimate and lucrative trade."[1] Though however the term "strangle" very aptly indicates the nature of the injurious influence which the ownership of links of canal by railway companies has had on our inland navigation system, this statement is calculated to give an erroneous and unfair impression as to the mode in which that influence was acquired. It must always be remembered in considering the history of the competition between them that the canal companies, upon whose undertakings £14,000,000 had been expended by 1830, had the advantage of being the first in the field. They were wealthy corporations whose position had been fully assured when that competition began, while railway companies were still contending with the strenuous opposition of the landed interest and the general distrust of the public for the new mode of transport inaugurated by the opening of the Stockton and Darlington line in 1825. As none of the great trunk lines had then been projected, and the total mileage of the railways can barely have exceeded 3000 miles,[2] the railway companies can hardly have been in a position to make the "adroit selection" of waterways attributed to them by Mr

[1] App. ii., p. 238.

[2] The construction of 3000 miles had been authorised under some 300 Acts by the end of 1840.

Conder, and their rapid acquisition of the property of their rivals appears to have been largely due to the eagerness of the latter to realise their capital for the purpose of embarking in railway enterprise. The canal companies appear indeed to have been as much carried away by the railway mania as the rest of the nation, and in many cases actually put pressure on the railway companies to compel them to purchase their canals when applying for powers to make their railways. Though canals like the Oxford, Coventry, and Trent and Mersey were still paying dividends of of 25, 26, and 30 per cent. in 1846, by the end of that year 852 miles of waterway in England and Wales, owned by twenty-two companies, and 92 miles in Ireland belonging to the Royal Canal Company had passed into the possession of the railway companies. Of these 944 miles, the Royal Canal in Ireland, and 146 miles owned by seven companies in England and Wales were sold, and 147 miles owned by another seven were leased, either in perpetuity or for 999 years to railway companies. One company, the Birmingham, whose canal was 160 miles in length, obtained a guarantee in perpetuity from the London and North-Western Railway Company, which agreed to make up the deficiency when the income of the canal was insufficient to produce 4 per cent.; while five companies, owning together 175 miles of waterway, were amalgamated with, and two, owning together 223 miles, were converted into railway companies.[1] It was only natural that the railway companies should make the most of the opportunities thus offered to them, and

[1] See statement of Mr Calcraft, *Report of the Select Committee*, 1883, App. 3, pp. 215-16; and as to the action of the canal companies, *A History of the English Railway*, by John Francis, vol. i., pp. 101-14.

while some of the lesser ones, under powers conferred by their Acts, converted portions of canal into railways, which they used as a means of putting pressure on large railway companies whose traffic was affected by them to buy or lease from them the whole canal and railway, others acquired canals with the sole view of removing all danger of competition.[1] By 1872, when their mileage had increased to 15,814 miles and their capital amounted to £569,047,346, the railway companies had acquired 1259 miles, or nearly one-third of the waterways of England and Wales, 85 miles, or one-fourth of those of Scotland, and 92 miles, or more than one-sixth of those of Ireland—a total extent of 1436 miles,[2] which has now been increased to 1443 miles[3] and the ownership of which is divided between thirteen companies in England and Wales, two in Scotland, and one in Ireland. They thus control more than one-third of the 4764 miles of waterway in the United Kingdom; and while the mileage of their railways is now 22,435 miles, or more than four times as great, their capital has increased to £1,245,028,917, or more than thirty-two times that of the canal companies which, according to the Board of Trade Return of 1898 is £37,929,279.[4]

[1] *Report of the Select Committee*, 1883 (evidence of Messrs Calcraft and Allport), Qu. 16-19, 61-66, 564-69; cf. *British Railways and Canals*, by "Hercules," pp. 95-96.

[2] *Ibid.*, App. 3, pp. 115-16.

[3] *Cf.* Mr Wells' paper at the Birmingham Conference, p. 28, as to England; and as to Scotland and Ireland, *Board of Trade Return*, 1898, p. 5, and pp. 219-221 of present chapter, *ante*.

[4] Cf. *Board of Trade Return*, p. 5; and as to the comparative progress of railways and waterways, an article by the authors on Inland Navigation in the *London Quarterly Review* for 1886, No. cxxxii., pp. 226 *et seq.*, and a paper by Mr U. A. Forbes read at the Conference on Canals, 1888, *cf.* the *Society of Arts Journal*, vol. xxxvi., pp. 768 *et seq.*

If, however, the canal companies must be regarded as in a great measure responsible for the rapid supersession of their undertakings by those of the railway companies, the predominant position of the latter is equally attributable to the failure of the Legislature to recognise the value of our waterways as an essential part of the national system of internal communications. That it was at first fully alive to the importance of maintaining a strict control over the development of railway enterprise is evident from the fact that, upon the Report of a Committee in 1844, of which Mr Gladstone was chairman, it passed an Act[1] providing for the revision by the Treasury of the scale of tolls of railways, if, after twenty-one years from the passing of an Act for the construction of any future railway, the profits should exceed 10 *per cent.*, and empowering the department "to purchase any such railway on behalf of Her Majesty" at any time after the expiration of that period at the rate of twenty-five years' purchase of the annual profits. Owing, however, presumably, to the influence of the railway mania in the following year, this measure, which is still unrepealed, has never been enforced, and Parliament thus lost a valuable opportunity of providing a means for regulating the competition between railways and canals from the commencement of the railway movement. It might then, as has been well observed by the late Mr Conder,[2] have either compelled the railway companies to purchase the canals at fair prices and imposed on them the obligation of

[1] 7 and 8 Vict. c. 85, ss. 1 and 2. By section 3, however, railways in existence at the passing of the Act were exempt from both these provisions. *Cf.* Francis' *History of the English Railway*, vol. i., pp. 277-78.

[2] *Report Select Committee on Canals*, 1883, App. ii., p. 238.

maintaining them, which would have relieved their lines of slow and heavy traffic and thus reduced their expenditure by some 50 *per cent.*, or else have preserved the independence of canals by prohibiting their purchase by railway companies, and thus allowed the traffic of the country to pass into the more convenient and commercial channel, as in the case of the coaching and road transport. It elected instead, however, to adopt the policy of ignoring our inland navigation system altogether except when absolutely compelled to recognise its existence, and has thus enabled the railway companies to acquire a virtual monopoly of the internal transport of the country. The advisability of endeavouring to find some counterpoise to check the growth of this monopoly was clearly pointed out as early as 1846 in the Reports of two Committees on the subject respectively appointed in that year by the House of Lords and the House of Commons. It was also strongly urged in the Reports of the Royal Commission of 1865-67 and of the Joint Select Committee of 1872 on Railway Amalgamation, the latter of which reviews the whole history of legislation on the subject, and, after pointing out the failure of competition, "which is so powerful a regulator of most commercial affairs," as a means for controlling railways, advocates the development of inland navigation and the freedom of canals from railway control.[1] It was only however after these recommendations had again been successively repeated by the Select Committee on Railway Rates and Fares, 1882,[2] by the Select Committee on Canals,

[1] *Report*, p. 3

[2] Pp. xiii, xvi, and App. ii, p. 372; App. xxx., p. 395, and evidence of Mr Lester, 3357 *et seq.*

1883,[1] and in the final Report of the Royal Commission on the Depression of Trade, 1886,[2] that, owing largely to the action of the Railway and Canal Traders Association formed to promote the interests of inland navigation, they were at length partially adopted, forty years after they were first made, in the Railway and Canal Traffic Act 1888, and canals have therefore derived little benefit from the legislation preceding that measure which was not initiated till five years after the passing of the first Regulation of Railways Act. The first two Acts regulating canal traffic were not passed till 1845 when canals had been in existence for nearly a century; and while the first of these[3] authorised companies to vary their tolls on different portions of their canals and was thus calculated to impede rather than facilitate transport, the other[4] empowered them to act as carriers both on their own canals and on those connected with them, subject to the bye-laws of companies owning the latter —a system which had been abandoned by the railway companies some five years previously on account of its inconvenience,[5] and which has divided canal companies into two competing classes of *carriers* and *toll takers*. Some ten years later, when it had allowed the railway companies to acquire the power of manipulating the traffic throughout our inland navigation system, Parliament passed the Railway and Canal

[1] Evidence of Messrs Lloyd, Abernethy, Clegram, Conder, Morton, Clark, Sir A. Cotton, Gen. Rundall, R.E., and App. xviii., p. 257.

[2] *Report*, pp. ix, x, xxi, xxii, xxv, xxvii.

[3] 8 and 9 Vict. c. 28.

[4] 8 and 9 Vict. c. 42.

[5] Until the passing of the Regulation of Railways Act 1840, private carriers were still competing with the companies on the Great Western, Grand Junction, and some other lines, and in others, such as the line from London to Birmingham, they were the sole carriers, the company merely providing the trucks and engines.

Traffic Act 1854,[1] which requires canal companies "to make arrangements and afford all reasonable facilities for receiving and forwarding traffic without unreasonable delay and without partiality"—a measure which, like the Regulation of Railways Act 1873,[2] constituting the Railway Commissioners as a tribunal for both classes of bodies, and the Board of Trade Arbitrations Act 1874[3] which followed it, are framed on the assumption that railways and canals stand on an equal footing. It has also, indeed, thanks to the efforts of the late Mr George Smith of Coalville, who devoted a great part of his life to this and other kindred work, passed the Canal Boats Acts 1877 and 1884[4] which ensure the provision of

[1] 17 and 18 Vict. c. 31.

[2] 36 and 37 Vict. c. 48.

[3] 37 and 38 Vict. c. 40. Canal traffic is governed by the Regulation of Railways Act 1873, the Board of Trade Arbitrations Act 1874, and the Railway and Canal Traffic Acts 1888 and 1894, which together constitute the Railway and Canal Traffic Acts 1873 and 1894.

[4] 40 and 41 Vict. c. 60, and 47 and 48 Vict. c. 75. George Smith, the son of a brickmaker, was born at Clayhills, Staffordshire, on 16th February 1831, and began working at his father's trade at nine years old, but managed to educate himself and, while still a young man, to raise himself above his associates. After becoming manager of works at Coalville in 1857, he set himself to procure the amelioration of the condition of the children in the brickfields, and was chiefly instrumental in procuring the passing of an Act in 1871 for the purpose (34 and 35 Vict. c. 104). His efforts, however, created such ill-feeling amongst the trade that he was dismissed from his post at Coalville, and lived in great poverty till 1888, when he received a grant from the Royal Bounty Fund which enabled him to buy a house at Crick near Rugby. It was during this period that he turned his attention to the amelioration of the class employed on barges and succeeded in procuring the passage of the Canal Boats Acts. He subsequently made similar efforts on behalf of the gypsies which however proved unsuccessful, and founded a philanthropic society called after his name for promoting the three forms of benevolent work to which he had devoted himself. He died 21st June 1895. Cf. *Dict. Nat. Biog.*

adequate accommodation on and the sanitary condition of canal boats used as dwellings, and the enforcement of the Education Acts with respect to children inhabiting them ; but as it has never attempted to provide for the maintenance of our inland navigation system, the decline of traffic resulting from its deterioration has, during the ten years between 1891 and 1901, reduced the numbers of the class for whose benefit these valuable measures were passed from 11,373 to 6869, and the number of boats occupied by them from 4301 to 2649.[1]

Lastly, through its acquiescence in this process of deterioration it has also deprived its most important enactment on the subject, the Railway and Canal Traffic Act 1888, which if it had been passed half a century earlier might have materially contributed towards the preservation and development of our waterways, of half its value. After permitting railway companies to acquire one-third of the waterways of the United Kingdom it has at length recognised in this Act that they ought not to own canals, and, after the majority of them have ceased to have any wish to do so, has prohibited them from applying their funds for the acquisition of any canal interest without express statutory permission.[2] It waited till a large proportion of the canal companies had been reduced to the verge of bankruptcy to enact that they shall regularly supply the information with respect to their condition which

[1] *General Report of the Census Commissioners*, 1901, p. 164. In Lancashire and Cheshire the decrease in the number of barges, which with a few exceptions was general throughout the country, exceeded 50 *per cent.*

[2] Sect. 42.

railway companies have since 1840 been required to furnish to the Board of Trade. And it may be noted that, while the amount of such information furnished by the annual returns made by canal companies to the Registrar of Joint Stock Companies is limited to the name, the address of the office, and the principal officers of the company, and a short description of the canal, returns showing the capacity of such canal for traffic, and the capital revenue, expenditure, and profits of the company are to be made only when required, and to another authority — the Board of Trade—which has only twice ordered the companies to furnish them during the seventeen years since the passing of the Act.[1] Owing to the belated character of these two otherwise important provisions of the Act, others which are intrinsically of equal value have hitherto remained a dead letter. On the one hand, it empowers the Railway and Canal Commissioners to make orders for the alteration of rates levied on canals owned by railways where they can be proved by persons interested to be calculated to divert the traffic to the railway to the detriment of the canal or persons sending traffic over it, or other canals adjacent to it;[2] while it extends provisions of the Railway and Canal Traffic Act 1854 and the Regulation of Railways Act 1873, previously of little value, requiring railway companies to afford all reasonable facilities for forwarding traffic from railways to canals.[3] On the other, it authorises canal companies to enter into contracts and arrangements for through tolls,[4] and to establish a clearing system

[1] Sect. 39. The returns frequently referred to in this chapter were issued in 1890 (for 1888) and in 1898.

[2] Sect. 38. [3] Sect. 37. [4] Sect. 43.

on the lines of that provided thirty-eight years previously for railways under the Railway Clearing Act 1850;[1] and it also provides for the inspection by the Board of Trade of all canals the condition of which is dangerous to the public or liable to cause obstruction to traffic, and their abandonment if necessary, or, should the Board think fit, their transfer to any person or body of persons or local authority.[2] Were the canal companies in a position to utilise them, the systematic application of these various provisions would materially aid them in freeing themselves from the control of the railway companies, and, by combining their at present conflicting interests, forming an organisation capable of competing with them. That they are not, is however sufficiently proved by the statistics with respect to the revenue derived from canal traffic given in the Board of Trade Return for 1898. No less than *twenty* of the seventy-nine independent waterways of England and Wales, and *nineteen* of the twenty railway-owned canals, are there shown to be carried on at a loss amounting in the case of the former to £19,623 and in that of the latter to £29,215; while the net profits of the whole of the independent waterways were not more than £598,360 and those of the railway-owned canals were only £46,236—a total of £604,497. While *thirteen* railway companies have a net revenue of over £1,000,000 and *seventeen* of over £100,000, and there are only two

[1] Sect. 44.

[2] Sects. 41 and 45. The following waterways have been inspected under sect. 41 — the Ouse Navigation (1890), the Kennet and Avon Navigation (1891), London and Hampstead Canal (1891), and the Nen Navigation (1894).

with a revenue below that amount, the two highest net revenues earned by the canal companies are those with respect to the Birmingham canals (£119,193) and the Manchester Ship Canal (£103,663). Of the independent waterways, only *eight* in England and Wales—the list of which is headed by the Aire and Calder (£92,057), Leeds and Liverpool (£50,642), and Grand Junction (£48,840)—and the Grand Canal in Ireland (£23,613), and of those owned by railway companies, only the Trent and Mersey (£20,834), and the Lancaster (£18,728)—owned respectively by the North Staffordshire and London and North-Western Railway Companies—in England and Wales, and the Forth and Clyde (£20,830) in Scotland, have a net revenue of between £10,000 and £100,000. A net revenue of between £1000 and £10,000 is earned in England and Wales by *eleven* independent waterways, the highest figures being those for the Calder and Hebble and the Stafford and Worcester, both of which exceed £7000, and by the railway-owned Manchester Bolton and Bury Canal[1] (£8869) and the Shropshire Union Canals[2] (£1099); in Ireland by *one* independent and *one* railway-owned canal—the Lagan and Ulster (£2436) and the Royal (£6148); and in Scotland by the Edinburgh and Glasgow Union which is owned by the North British Railway Company (£3540). Of the remaining waterways mentioned in the Board of Trade Return, only seven of those in England and Wales which are independent, and two which are railway owned, and two

[1] Lancashire and Yorkshire Railway Company.

[2] Shropshire Union Canal and Railway Company, which is practically owned by the London and North-Western Railway Company.

independent waterways in Scotland, show a net revenue of over £500, the highest amounts being £891 and £814 respectively earned by the Ouse and Foss Navigation Company and the Caledonian Canal Company, both of which are independent waterways.[1] It is therefore evident from these figures that only about a dozen of the canal and navigation companies are making a fair profit on their undertakings; that the income of the remainder is in a minority of cases just sufficient, and in a majority is insufficient for maintaining them; and that the Railway and Canal Traffic Act of 1888 has thus left them as much at the mercy of the railway companies as they were before its passing.

Where a railway company owns an entire canal, as in the case of the London and North-Western Company which controls the two longest canals in England—the Shropshire Union which is 200 miles and the Birmingham Canal which is 159 miles in length—it can regulate the traffic for the benefit of its railway. Where it owns only a portion of a waterway, as in the case of the Great Western, which controls a portion of each of two of the three routes between the Severn and the Thames[2]—namely that *viâ* the Stroudwater and Thames and Severn Canal, and that *viâ* the Avon, Kennet and Avon Canal, and Kennet—it can fetter the traffic on the other portions; and it is owing to the two-fold control over our waterways thus acquired by the railway companies that, as was pointed out by General Rundall, R.E., in his evidence before the

[1] Cf. *Board of Trade Return*, 1898, No. 2, Traffic, pp. 82-125.

[2] *Cf.* Mr Wells' paper on Canals, *Proceedings of the Birmingham Conference*, 1895, pp. 30-44.

Select Committee on Canals 1883, the condition of the former is so imperfect that it is impossible to draw any comparison between the two as regards competition.[1] The ownership by a railway company of any portion of a canal system inevitably creates a block which effectually prevents the establishment of through rates and tolls for facilitating through traffic which, as has been shown, canal companies are required by Parliament to provide, while amalgamations between independent companies have been frequently rendered abortive by the ownership of some important link by a railway company.[2] It was stated to the Committee by Mr Lloyd that "almost every through route has links in it, and some more links than one, under the control and ownership of a railway company";[3] and many instances were given by other witnesses of the injury to inland navigation which has resulted from the fact. By charging excessive tolls, keeping their canals narrow, offering bonusses to merchants to send cargoes by special lines, and making rules calculated to fetter traders who attempt to convey their goods entirely by water, the railway companies have induced what the late Mr Conder termed a state of "creeping paralysis" among canal companies,[4] the impoverished condition of which has,

[1] *Report*, Qu. 3060.

[2] *Ibid.*, evidence of Sir F. Peel, Qu. 3417-19; and *cf.* Mr Lloyd, Qu. 312, and Mem. by Mr Burchell, App., p. 292.

[3] *Ibid.*, Qu. 370.

[4] *Ibid.*, Qu. 1816-22, 1973, 2050, 3468-70; and App. pp. 395-96, containing a memorial of the Association of the Chambers of Commerce of the United Kingdom; *cf.* also *Report, Select Committee on Railway Rates and Fares*, 1882, pp. 4, 5, and *London Quarterly Review*, 1886, No. cxxxii., pp. 226-27.

in a large majority of cases, rendered it impossible to make the improvements necessary to enable them to compete successfully with their wealthier rivals.

The greater number of canals still retain their original form of construction,[1] and are practically enlarged ditches with a top water of about 30 feet and a bottom of 14 feet and with inclined slopes on either side—a form which is known as the V shape, and which produces a constant silting, and a tendency to fill up at the bottom, with a consequent variation in the depth of the waterway in different canals which is a serious impediment to traffic. In addition to this, neither the locks nor the canals themselves are of sufficient dimensions to allow boats to pass each other properly,[2] and throughout Great Britain, and especially in England and Wales, there are scarcely two canals that have a common guage, and there are even sometimes two or three different guages of locks upon the same canal.[3] Of the independent waterways, which are of necessity those on which improvement is chiefly to be looked for, only about 20 per cent. can admit craft that would enable them to realise the full value of economical transport;[4] and while there are 1240 miles of what Mr Wells describes as "narrow boat canals," which provide for boats carrying cargoes of from 18 to 30 tons, and 2040 miles of "shallow barge canals" adapted for boats carrying cargoes of from 40 to

[1] It was stated by Mr Salt in a paper read before the Birmingham Conference of 1895, that there is one in Birmingham in the original state in which it was left by Boulton and Watt in 1796, cf. *Proceedings*, p. 110.

[2] *Report*, 1883, Qu. 2754. [3] *Ibid.*, Qu. 88, 95, 103.

[4] *Cf.* Jeans' *Waterways and Water Transport*, p. 56.

60 tons, the total extent of the few canals and navigations which, like the Aire and Calder and the Weaver, have been enlarged and improved to accommodate boats carrying from 90 to 350 tons of cargo is only 230 miles.[1] Though some of the waterways under public trusts, and notably the more important rivers—such as the Thames, Severn, Lea, Clyde, Forth, and Shannon—are in a far better position than those dependent on private enterprise,[2] the condition of the Ouse and the Nen as described by Major Marindin, R.E., in two reports of 1891 and 1894 made to the Board of Trade, under section 41 of the Railway and Canal Traffic Act 1888, may be taken as typical of that of many others. The works and channel of the Ouse are, he states, in such a "lamentable condition," that unless a large expenditure be immediately incurred in restoring such works, dredging, and clearing away banks and reed beds which are rapidly extending, there is imminent risk of the river becoming useless at no very distant date;[3] while barges and lighters trading on the Nen between Wisbeach and Peterborough are subjected to "very great delays and difficulties" through the numerous shoals, and the navigation of the third division of the river for the first 7 miles below Peterborough has largely deteriorated through the neglect to carry out works of maintenance, and will continue to do so until they are undertaken.[4]

[1] Cf. *Proceedings of Birmingham Conference on Canals*, 1895, pp. 31, 32; and *Society of Arts Journal*, vol. xlvii., p. 165.

[2] *Waterways and Water Transport*, p. 57.

[3] *Report*, p. 7. Even in its defective condition it is cheaper to send goods to Newcastle, Leith, etc., by barge to King's Lynn and thence by steamer, than by railway. *Report*, p. 9.

Though, however, the defective condition of our waterways is undoubtedly in a great measure the result of the hostile action of the railway companies, it is also very largely due to the want among the bodies controlling them both of the enterprise and of the capacity for concerted action to which the "railway interest," as it is well termed, owes its success, or, in other words, to the fact that there never has been any "*canal* interest." The railway system owes its origin to a handful of competing companies which at its first initiation were as averse to the idea of combination as the canal companies still, apparently, remain, and as ignorant as were the public in general of the true nature and capacity of that system. Railways were regarded as a species of "land canals," the promoters of which were desirous only of being toll proprietors, and considered it against their interest to attempt the carriage of passengers and goods; and we find the Legislature enacting that any person might run his trains over the lines on paying certain tolls, that owners and occupiers of adjoining lands might make branch lines and have free access to the railway, and that lords of manors and others might erect wharves and use such portions of the railways as passed through their lands free of all charge.[1] Within half a century, however, the railway companies, despite these unfavourable conditions, have constructed a series of great through routes, the control of each of which has, by means of amalgamation, been transferred from a number of competing bodies

[1] Cf. *The Five Reports on Railway Communication*, 1840 *passim*, and paper by Mr Forbes above referred to in *Society of Arts Journal*, vol. xxxvi., pp. 76-78.

to a single authority—the London and North-Western Company, for instance, comprises between forty and fifty companies—and on each of which a carrying trade has been organised. They have enormously increased the facilities for through traffic and at the same time consolidated their interests by the establishment of the *clearing* system; and no more striking illustration can be given of the superiority of their position to that of the canal companies than the fact that while the ownership of the 22,455 miles of railway in the United Kingdom is divided amongst some *thirty-eight* companies, that of the 3321 miles of waterway which remain independent of railway control is shared between more than double that number of canal companies and navigation trustees.

The railway companies have thus earned their success by combining to carry out a few simple principles of organisation and management none of which the canal companies have, during their one hundred and fifty years of existence, ever attempted to adopt. Though there are nineteen through routes by water in England and Wales there is not one which has the advantage, enjoyed by each of the railways with which they compete, of being under a single body. On the *three* routes connecting London and Liverpool there are, including the authorities of navigable tideways such as the Mersey, Severn, and Humber, *twenty-six* different bodies—and were until 1894 *twenty-eight*—which compete with each other; and there are *twenty-seven* on the *four* routes between London and Bristol, *ten* on the *three* between Birmingham and Bristol, and the same number on the *three* between Hull and Liverpool. On the

shortest of the three last-named through routes[1] a consignment of goods has to traverse ten different waterways, the guages on the locks of which range through various grades from 50 feet by 14 feet by 4.6 feet on Sir John Ramsden's canal, to 212 feet by 22 feet by 9.6 feet on the Aire and Calder. The sectional area of the latter canal again is 475 square feet, that of the Trent and Mersey 136 square feet, and that of the Weaver navigation 780 square feet. The smaller canal locks have an average width of 7 feet, while that of the Aire and Calder reaches 18 feet, and as a similar variety of dimensions prevails on all the canals on every through route throughout the United Kingdom it is not surprising that the injurious delays thus entailed should drive the trader to employ the more direct means of transit provided by the railways.[2]

In addition to this a large majority of our navigable rivers are in a worse position as regards management than the canals, for while the control of each of the latter is vested in the company to which it belongs, the Thames, as already stated,[3] is the only river in the United Kingdom the whole course of which from its

[1] From the Mersey *viâ* the Duke of Bridgwater's, Rochdale, Ashton, Huddersfield, and Sir John Ramsden's canals, and the Calder and Hebble navigation, to the Aire and Calder, and thence to Liverpool.

[2] *Report of Select Committee on Canals*, 1883, App., p. 216, and evidence of Mr Lloyd; and a paper by Mr Forbes, *Transactions Instit. Mining Engineers*, vol. viii., pp. 419-31. Of the three routes between London and Liverpool above mentioned that *viâ* the North Staffordshire and Bridgwater Canals was originally worked by *nine* companies. This number is now reduced to *seven* by the purchase of the Grand Union and the Leicestershire and Northampton Union Canals by the Grand Junction Company in 1894.

[3] *Cf.* chap. ix., p. 160 *ante.*

source to the sea is under the control of a single authority. The Commissioners of the Severn, which is 200 miles long, and the seventeen tributaries of which have a united length of 250 miles, are indeed the sole authority for that river, but the only portion of it under their control is the 42 miles between Stourport and Gloucester.[1] The Humber, 20 of the 38 miles of which form an estuary 1 mile in width at Hull and expanding to 5 miles at its mouth, and which receives the Ouse, Derwent, Trent, and most of the drainage of the northern part of the kingdom, is under a conservancy commission which deals only with the navigation and has nothing to do with the care of the banks;[2] and in the case of the Tyne, Clyde, Wear, Tees, Usk, Mersey, and Ribble the control of the governing body is limited to the tideway.[3] The only conservancy authority on the Trent, which is 167 miles long with ten tributaries having a united length of 293 miles, is a navigation company controlling the 73 miles from Gainsborough, 26 miles from the Humber, to a point 13 miles above Nottingham;[4] while the Medway and the Warwickshire Avon, which are respectively 69 miles and 57 miles in length, are each governed by a pair of conservancy authorities, one of which controls the upper and the other the lower river. The number of

[1] *Cf.* Mr E. D. Marten's paper on the Severn Navigation, *Proceedings of the Birmingham Conference on Inland Navigation*, 1895, p. 83; and *ante* chap. ix., pp. 158-59, and *Report of Select Committee of House of Lords*, 1877, *on Conservancy Boards*, Qu. 2519 *et seq.*, 1586 *et seq.*

[2] *Ibid.*, Qu. 1752, 2137 *et seq.*, 2338-41, 2494-97.

[3] See chap. ix., pp. 150-51, and chap. x., pp. 198-99 *ante*.

[4] *Report of Select Committee of House of Lords*, 1877, Qu. 311, 1198 *et seq.*, 1217 *et seq.*

authorities governing a river seems indeed to vary in inverse ratio to the size, for while the conservancy of the 57 miles of the Kennet and Avon navigation is shared between the Thames Conservancy, the Reading Local Board, the Great Western Railway Company, and the Bristol Dock Company, that of the 31 miles tidal portion of the Nen is intrusted to *eight* public bodies,[1] and the Witham with a length of between 80 and 90 miles is ruled by *seventeen* different sets of commissioners.[2]

Again, with respect to the organisation of the carrying trade, which has perhaps contributed more largely than any other cause to the success of the railway companies, navigation trustees and canal companies are in much the same position as their rivals were before the passing of the Railway Regulation Act 1840, when private carriers were still competing with railway companies on some lines, such as the Great Western and Grand Junction, and were the sole carriers on others.[3] Only ten in England and Wales, all of which except the Shropshire Union Railway and Canal Company are independent, and three in Ireland — thirteen out of seventy-nine, or about one-sixth of the whole number—have made use of the powers conferred on canal companies in 1845[4] of acting as carriers, and all of these except one—the Woking and Basingstoke

[1] *Report of Select Committee of House of Lords*, 1877, Qu. 427 *et seq.*, 997 *et seq.*

[2] *Ibid.*, Qu. 1755 *et seq.*, 187 *et seq.*, 2827 *et seq.* *Cf.* an article on River Conservancy by the authors in *London Quarterly Review*, 1883, No. cxix., pp. 36-37.

[3] Cf. *A History of the English Railway*, by John Francis, vol. ii., pp. 9-10.

[4] By 8 and 9 Vict. c. 42.

Canal—have, from the fact that they are only links in through routes, to compete with private carriers, or, as they are termed in the Board of Trade Returns "bye-traders." The reluctance of the canal companies to profit by the example of the railway companies is evident from the difference of opinion displayed by the witnesses examined on the subject by the Select Committee on Canals 1883, some of whom, like Mr Clark of Wolverhampton, advocated that carrying on canals should be entirely intrusted to private carriers, while others, such as Mr Lloyd, the manager of the Warwick canals, and Mr Bartholomew, the Engineer of the Aire and Calder navigation, strongly urged the advisability of canal companies acting as carriers. Canal companies can, of course, never obtain the full benefit of the latter policy until they have, like the railway companies, succeeded in acquiring the sole control of through routes and have been freed from the competition of bye-traders. Its advantages, even when it is hampered by this competition and applied only to isolated links of waterway, is shown by the evidence furnished by the Board of Trade Returns 1898, with respect to the relative numbers and commercial importance of the canals which act as carriers as well as toll takers and those which are toll takers only. The total revenue from all sources of the English and Welsh canal companies, which have a combined mileage of 3167 miles 16½ chains, is £2,226,811, and no less than £1,030,518, or more than half of this, is earned by the ten companies that act as carriers, the united mileage of whose waterways is only 735 miles 22 chains; while the three Irish companies acting as carriers, whose

waterways have a combined mileage of only 223 miles 23 chains, earn £92,547, or more than three-fourths of the total revenue of £114,714 derived from all the waterways of Ireland, the total mileage of which is 586 miles 32 chains. Though in the majority of cases the traffic conveyed by bye-traders on these canals greatly exceeds, as might be expected, that conveyed by the companies, the revenue they earn as carriers *as* greatly exceeds that which they derive from tolls. Thus, on the Manchester Ship Canal the traffic on which conveyed by the company—exclusive of such as is sea-borne, and of that using Runcorn Docks and the tidal waters of the Mersey[1]—amounts to only 631,043 tons as against 1,173,040 tons conveyed by bye-traders, £212,075 out of a total revenue of £296,510 is earned by the company as carriers and only £59,757 from tolls. On the Aire and Calder, where the traffic conveyed by the company is 770,786 tons, and that conveyed by bye-traders 1,641,276, the total revenue of £276,697 is made up of £154,714 from the former as against £54,718 from the latter source. In the case of the Leeds and Liverpool Canal, the total revenue of which is £164,392, the 2,014,776 tons of traffic conveyed by bye-traders only produces £45,026, while less than one-sixth of that amount—310,192 tons—conveyed by the company yields £102,734; and in that of the Rochdale, with a revenue of £57,190, the tonnage of the traffic conveyed by bye-traders is more than five times that conveyed by the company

[1] The sea-borne traffic is returned as 2,218,005 tons, that using the railway sidings of the company at Runcorn as 3,589,822 tons, and other traffic passing free of toll in pursuance of certain special powers in the company's Acts as 322,956 tons—a total of 6,130,783 tons.

—525,537 tons as against 98,890 tons—and the revenue from tolls is not much more than a quarter of that amount—£14,876 as against £32,070. The comparative unimportance of tolls as a source of revenue is, however, still more clearly shown by the fact that the tonnage of the traffic carried by the companies on the Shropshire Union Canal and the Grand Canal of Ireland—which respectively stand *fourth* and *seventh* as regards earnings and are also the two longest amongst the canals of the United Kingdom—is in both cases more than double that carried by bye-traders; and that on the Strabane Canal, which, though one of the shortest in the United Kingdom, stands *fifth* as regards earnings among the Irish canals, it is more than thirteen times as great.[1] The Shropshire Union Company with a revenue of £184,127 earned £167,739 as carriers and only £5505 in tolls, the Grand Canal, with a revenue of £89,037, earned £72,943 as carriers and only £8260 in tolls, and the Strabane Company, with a revenue of £2913, earned £2868 as carriers and only £41 in tolls; while on the Basingstoke Canal, on which there are no bye-traders and which is only 37 miles in length, the company earned £3289 from freight as carriers—a sum nearly equal to that of the combined earnings in tolls of the Glamorgan Canal Company and the Trent Navigation Company—£1551 and £1990 respectively—the first of which is 25 miles and the other 68 miles

[1] The length of the Shropshire Union is 200 miles 67 chains, that of the Grand Canal 209 miles 18 chains, and that of the Strabane Canal 4 miles 5 chains. The tonnage of the traffic carried by the companies was 371, 979 tons, 221,895 tons, and 22,231 tons respectively as against 152,545 tons, 89,303 tons, and 1647 tons conveyed by bye-traders.

long. The railway companies, as was pointed out by Mr John S. Forbes in his evidence before the Select Committee on Railway Rates and Fares, 1882,[1] were led to become carriers themselves by the discovery that the private carriers, who were not subject to the regulations as to the publication of tariffs, limitation of charges, and general government by which they themselves were bound, were making use of the railways against them. That canal companies are in precisely the same position with respect to bye-traders is evident from the statement of Sir Frederick Peel before the Select Committee on Canals, 1883, that as private carriers were not under their jurisdiction the commissioners were unable to deal with complaints respecting charges for the conveyance of traffic by canal except so far as it had reference to the tolls for the use of the navigation,[2] and there seems, therefore, every reason for believing that they would benefit by the adoption of a similar policy.[3]

Lastly, no attempt has ever been made by the canal companies to utilise the provisions of the Railway and Canal Traffic Act 1888, with respect to the establishment of a clearing system, the advantages of which have been repeatedly demonstrated —notably in a report on the subject to the Cheshire Conference on Railway and Canal Rates by their Counsel, Mr Waghorn, in 1892—and in two articles published in the November and December numbers for that year of the *Canal Journal*, which has now long been withdrawn from publication. It is largely

[1] *Report*, Qu. 2430. [2] *Ibid.*, Qu. 3417.

[3] See article above referred to in *Transactions Instit. Mining Engineers*, vol. viii., pp. 419-31, and *Board of Trade Return*, 1898.

owing to the existence of that system that, as pointed out by Mr Wells, "railway companies do not compete in rates."[1] When the determination to carry on their own account was arrived at, as above mentioned, the London and North-Western and other railway companies agreed, by a series of resolutions adopted at a meeting held in London on 19th January 1847, to conduct their carrying operations in connection with each other, to adopt the system of classification in operation on the London and North-Western line as a common basis, to accept a uniform mileage rate according to the mileage run over each line, and to deduct and allow terminal expenses previous to any division of profits.[2] The extent to which canal companies might benefit by the adoption of the principles embodied in the above resolutions may be gathered from an illustration of the mode in which the organisation of traffic is constantly impeded by the local jealousies of competing companies, which was given by Mr Lloyd in his evidence before the Select Committee on Canals, 1883. Where, he says, a valuable product, such as road-stone, is centered upon a canal owning a short link of communication, it pays, perhaps, to the originating company a toll of 6d. per ton, to the next company a toll of 1s. per ton, and to the third company another 6d. per ton, making a total of 2s. "But in another direction to supply a separate and distinct area, in consequence of the severe competition of railways, it is necessary that all the companies interested should take a less

[1] *Proceedings of Birmingham Conference*, 1895, p. 35.

[2] Evidence of Mr John S. Forbes, *Report, Committee on Railway Rates and Fares*, 1882, pp. 159-60.

mileage toll than forms their proportion of the 2s. The originating company says—'No, we have got possession of this traffic and mean to have our 6d.' And the second company says—'No, we have got possession of this traffic and mean to have our 1s.' The third company, therefore, has to bear the whole brunt of the competition though it is practically the distributing company." [1]

Until canal companies realise the injurious character of internecine conflicts of this description and adopt the principles of co-operation which have proved so serviceable to their rivals, neither they nor the traders can hope to enjoy the full benefits of our inland navigation system, which, despite its extent, and the valuable means of intercommunication which it provides between the principal ports and industrial centres of the kingdom, has been reduced through their own apathy and the neglect of the Legislature to a state of inefficiency which has enabled the railway companies to ignore its existence in fixing their rates for traffic—a result the consequences of which have been graphically described by Mr Jeans in a paper read before the Birmingham Conference on Inland Navigation in 1895. "Comparatively few people," he says, "stop to inquire the amount of the toll which the railway companies are accustomed to take from the inhabitants of these islands in the form of transportation charges. It now amounts to £2 per head of the entire population. It is more than four times as much as the total local taxation of the kingdom. It is almost as much as the total amount of the national income for State purposes. It is more

[1] *Report*, Qu. 685-88.

than the total value of the total mineral product of all kinds including coal. It is nearly as much again as the total rent of the country for agricultural purposes, and it is nearly a tenth part of the estimated income of every class of the community."[1]

[1] "The Comparative Conditions and Cost of Transport by Railway and Canal." *Proceedings of the Birmingham Conference*, 1895, p. 18.

CHAPTER XII

THE RESUSCITATION OF OUR WATERWAYS

Revival of interest in inland navigation. Discussions by learned societies. The Manchester Ship Canal. Amalgamations of various canal companies. Resolutions by Chambers of Commerce. Meeting of Associated Chambers at Manchester 1904. Comparison between resolutions of 1882 and 1904. Variation in transport rates between Manchester and Liverpool during interval from construction of the Bridgwater to that of the Manchester Ship Canal. The Canals Trust Bill 1905. Improvement of waterways now generally regarded as the best means of lowering railway transportation charges. Arguments in favour of cheapness of water transport. Development of waterways in other countries. Answer to objections to waterways. Principles to be observed in development of water transport. Improvements in construction. Uniformity of guage. Steam haulage. Canal boats. Capacity of canal companies to effect some of these improvements. Amelioration of administration and controlling supervision. Necessity for appointment of a commission of experts to determine standard dimensions of canals and fix scale of traffic charges. Three methods of establishing controlling supervision. 1. Extension of supervisory powers of Board of Trade while retaining independence of canal companies. Merits and defects of scheme. 2. Establishment of a Canal Trust. Merits and defects of scheme. 3. The nationalisation of waterways. Answer to objections. Arguments in favour of scheme. Conservancy of navigation only one branch of water conservancy. Connection with water-supply. Recommendations of Salmon Fisheries Commission 1902 with respect to a Central Water Authority and Watershed Boards, and a survey and estimate of sources of supply in watershed areas throughout the kingdom. Suggestion for entrusting control of waterways after acquisition by State to proposed Central Water Authority. A Government Water Department for administration of scientific water conservancy.

As was stated in the introduction to this work,[1]

[1] Chap. i., pp. 5-7.

the various parliamentary inquiries and Acts relating to inland navigation referred to in the last chapter are the outcome of a gradual revival of interest in the subject which began a little over a quarter of a century ago. This has been shown by its discussion from time to time by bodies like the Institution of Civil Engineers, the Society of Arts, and the Associated Chambers of Commerce of the United Kingdom, and more especially at the meeting of the British Association at Dublin in 1878, and at the Conferences organised by the Society of Arts in London in 1888, and by the Institution of Mining Engineers at Birmingham in 1895. It has also manifested itself in various "canal projects," such as that for the construction of a national canal capable of accommodating steam barges to connect the Thames and the Mersey, advocated by Mr Lloyd in a pamphlet published in 1885;[1] for a ship canal between Goole and Sheffield; for a canal from the Irish Sea to Birkenhead through Wallasey Pool and the Wirrall Peninsula; for a canal connecting Birmingham with the Trent and the North Sea; for an improved waterway between the Midlands and the Thames; for the improvement of the Wilts and Berks Canal, so as to give better inland transport between Bristol and London; and for a ship canal between the Mersey and Birmingham, connecting with the Manchester Ship Canal and the Mersey by way of the Weaver.[2] It has borne practical fruit in

[1] *England needs Inland Steam Navigation.* In a prefatory letter to Mr John Bright, Mr Joseph Chamberlain, and Lord Randolph Churchill, the author advocates the construction of this work on account of the number of unemployed workmen in the Midlands, p. ix.

[2] *Cf.* Jeans' *Waterways and Water Transport*, pp. 20, 83.

the construction of the Manchester Ship Canal—the most important event in the history of waterways since the opening of the Bridgwater Canal—which, though the proposal did not assume a practical form until taken up by the late Mr David Adamson in 1881, and the works begun in 1885 were not completed until 1893, was first suggested to the Manchester Chamber of Commerce by Mr Hamilton Fulton as early as 1877.[1] Owing, doubtless, largely to the success of this great work it has led to the amalgamation in 1894, under the Sharpness New Docks and Gloucester and Birmingham Navigation Company, of the Gloucester and Berkeley Ship Canal, and the Worcester and Birmingham, Droitwich Junction and Droitwich Canals; and in Ireland that of the Ulster, Coal Island, and Lagan Canals under the Lagan Navigation Company. It may also be traced in the purchase about the same time by the Grand Junction Canal Company of the Grand Union and of the Leicestershire and Northants Union Canals, and its acquisition of the control of the tolls between Birmingham and London by arrangement with the Oxford, Warwick and Napton, and Warwick and Birmingham Canal Companies; and in the purchase from the Manchester and Sheffield Railway Company of the Don navigation, which connects Sheffield, Rotherham, Barnsley, and Doncaster with the Trent at Keadby and the Ouse at Goole, by the Sheffield and South Yorkshire Navigation Company in 1895.[2] Lastly, the passing of a series of resolu-

[1] *Cf.* Gordon Thompson's *Canal System of England*, pp. 15-16.

[2] *Cf.* Mr Wells' paper at the Birmingham Conference, 1895, p. 48, and that of Mr Vernon Harcourt in vol. xlvii. of the *Journal of the Society of Arts*, p. 165.

tions on the subject by individual Chambers of Commerce during the last twelve months has led to an important discussion upon it at the Annual Meeting of the Associated Chambers of Commerce of the United Kingdom at Manchester on 24th December 1904, and a Canals Trust Bill has been introduced in the House of Commons during the session of 1905 with the object of giving practical effect to the conclusions then arrived at.

The discussion at the Manchester Meeting of 1904 above referred to was raised by a resolution submitted by the Manchester and Liverpool Chambers that "in view of the urgent necessity of cheapening the cost of the internal transit of goods and of the immense benefit to the whole community that is bound to follow from the modernisation and extension of our inland navigation, this association, being of opinion that the best results can only be obtained through unity of management, strongly urges that all inland waterways of the United Kingdom should be acquired by the State or by a suitably constituted national Trust." Though sixty-one chambers voted in favour of and forty against this resolution—the form of which was eventually modified by the addition that there should be a "Government guarantee, supervision, and control of any national Trust constituted for the purpose"—it was unfortunately finally lost on account of a rule of the Association that no action shall be taken in matters of this description unless there be a two-thirds' majority in its favour. It nevertheless demands consideration, both because the Association has, at five previous meetings, advocated the

compulsory purchase of canals by the Government;[1] and also because it may be usefully compared with another resolution passed at the annual meeting in London in 1882 to the effect, that "in order that commerce and agriculture may be able to take every advantage of the easily and cheaply worked traffic of the canals of Great Britain and Ireland," canals should be "entirely emancipated from the control of railway companies," which was subsequently embodied in a memorial presented on the 31st March in that year to Mr Joseph Chamberlain, then President of the Board of Trade. This memorial, in which attention was drawn to the evils resulting from the acquisition of canals by railways, and also to the recommendation in the Report of the Joint Select Committee of 1872 on Railway Amalgamation, that "encouragement should be given to independent canal companies to exercise compulsory powers" for the repurchase of railway-owned canals, was signed by only fifty-two chambers, which, though including those of Bristol, Cardiff, Dublin, Birmingham, Hull, Greenock, Leeds, Sheffield, Plymouth, and other important cities, did not comprise those of either London, Manchester, or Liverpool.[2] The increased number of votes in favour of the resolution of December 1904 therefore indicates a considerable advance in opinion on the subject during the intervening period, which is rendered more noteworthy by the fact that it emanated from the representatives of two cities which twenty years previously had declined to support the proposal that

[1] The last preceding meeting was at Huddersfield in 1896.

[2] *Report of Select Committee on Railway Rates and Fares*, 1882, App. 20, pp. 395-96.

canals should be freed from railway control, and whose opinions are especially worthy of consideration. Manchester—the cradle of the canal system, which it has, by the construction of the ship canal, been largely instrumental in preserving from extinction—and Liverpool, were the first cities in the United Kingdom to benefit both by canals and railways, and have also probably suffered more than any others from the prejudicial effects of the exclusive privileges successively conferred on them by the State. The cost of transportation between them, which had previously been 40s. per ton by road, was reduced to 1s. 8d. by the construction of the Bridgwater Canal. Within thirty years, when the traffic resulting from the growth of the cotton trade had so outgrown the capacity of the canal that it took longer to carry a cargo between them than across the Atlantic, and the company were able to dictate their own terms to the traders, it had risen to almost its original amount.[1] It was lowered again by the competition induced by the opening of the Manchester and Liverpool line only to rise once more after the railway company had in its turn acquired a monopoly, and in 1882 it was three times what it had been in 1795.[2] Lastly, the conveyance by the Manchester Ship Canal—which has been slowly but surely gaining the confidence of traders—of cotton and timber at nearly half, and of wool, sugar, wheat, petroleum, and tallow at less than half the cost charged by the railway companies, has now compelled the latter to lower their rates,[3] and it

[1] *Lives of the Engineers*, vol. iii., pp. 178-79.

[2] *Report of Select Committee on Canals*, 1883, pp. 233, 239 ; and *cf.* a paper read by Mr Jeans before the Statistical Society, 10th November 1886.

[3] Cf. *The Canal System of England*, Gordon Thompson, pp. 61-63.

is therefore not surprising that the advocacy of water transport by industrial centres which have had so much practical experience of its efficacy should have been favourably received by others that are endeavouring to find some counterpoise to the railway monopoly.

The Canals Trust Bill of 1905, above referred to, embodied the principle of the second portion of the Manchester resolution—namely, the establishment of a Canal Trust "to acquire, develop, extend, and administer in the public interest canals and navigations in England and Wales."[1] This measure, which was presented by Mr Rowland H. Barran, the Liberal Member for North Leeds, was supported by two other Liberals representing Yorkshire constituencies, five conservatives representing Lancashire constituencies, two Liberals and one Conservative, respectively representing constituences in Cheshire, Northants, and Staffordshire, by one Liberal and one Unionist, respectively representing Kincardineshire and the Camlachie Division of Glasgow, and by the Nationalist Member for the St Patrick Division of Dublin. A further proof of its importance is to be found in the fact that it was opposed by the London and North-Western, the Great Western, and the Midland Railway Companies, and it is therefore much to be regretted that the neglect of its promoters to comply with the regulation requiring Bills of this description to be advertised in the *London Gazette*, necessitated its withdrawal before Parliament had had the opportunity of pronouncing an opinion upon it. It proposed to incorporate a body, analogous to the London Water Board, comprising twenty-nine trustees, seven of

[1] Sect. 2, subsect. 1.

whom were to be appointed by the Treasury, seven by the Board of Trade, and seven by the Board of Agriculture and Fisheries, while the remaining eight were to be respectively appointed by the Port Authorities of London, Liverpool, Hull, and Bristol, the Association of Chambers of Commerce of the United Kingdom, the Central and Associated Chambers of Agriculture, the Mining Association of Great Britain, and the Mansion House Association on Railway and Canal Traffic for the United Kingdom.[1] This body was to be empowered to purchase, on terms to be agreed upon or determined by arbitration between it and the proprietors of the respective undertakings, the Birmingham, Coventry, Grand Junction, Leeds and Liverpool, Trent and Mersey, Oxford, Warwick and Birmingham, Warwick and Napton, Staffordshire and Worcestershire, Worcestershire and Birmingham, Droitwich, and Droitwich Junction Canals, the Berkeley Ship Canal, and the Kennet and the Avon and the Trent navigations.[2] The acquisition of these fifteen waterways, which in 1898 had a total traffic of 17,708,672 tons, a total revenue of £68,767, and a total capital of £7,669,593,[3] would have enabled the Trust to organise a system of through communication between London, Liverpool, Hull, and Bristol; and while two of them—the Kennet and Avon, and the Trent and Mersey—would thus have been freed from railway control, the dangers of railway influence were guarded against by a proviso that "no chairman, director, manager, or other official of a railway company shall be eligible for the offices of trustee, chairman, or vice-chairman."[4] The Trust was also to

[1] Sect. 2, subsect. 5.

[2] Sect. 3, subsect. 2.

[3] *Board of Trade Return*, 1898.

[4] Sects. 2, 3.

be authorised to acquire other canals and navigations by agreement or by a Provisional Order from the Board of Trade, which were to be managed either by it directly or by a "subsidiary or local Trust" to be formed for the purpose under a scheme to be approved by the Board of Trade.[1] Following the lines of the recent London Water Act, the Bill provided for the establishment of a canal fund, and empowered the Trust to borrow money for carrying out the Act, and for this purpose to issue guaranteed canal stock bearing interest at such rate not exceeding 3½ per cent. as it might determine "with the consent of the Board of Trade, and after consultation with the Governor of the Bank of England and the Treasury."[2] The tolls to be charged in respect of traffic and of the "rendering of any service or the use of any accommodation provided by the Trust" were to be regulated by a Provisional Order made by the Board of Trade,[3] but the Trust was to be prohibited from "undertaking or engaging in the business of carriers of traffic" on any of its canals.[4]

It will be evident from this summary of its provisions that the Canals Trust Bill 1905, considered in conjunction with the Manchester resolution and the evidences above given of an awakening of energy among the canal companies themselves, is an important indication that the burden of railway transportation charges to which Mr Jeans drew attention ten years ago, in the passage quoted at the close of the last chapter, is being increasingly felt by the commercial and industrial classes, and that the improvement of our waterways is generally regarded as one of the best modes of diminishing it. It is on

[1] Sect. 19. [2] Sects. 8-11. [3] Sect. 16. [4] Sect. 23.

the other hand maintained by advocates of the railway companies that it has never been satisfactorily demonstrated that this improvement will produce the results anticipated from it,[1] and it will therefore be advisable, before proceeding to consider the measures necessary for effecting it, and the merits of the various methods proposed for initiating them, to summarise the principal reasons which have been at various times adduced by eminent engineers in support of the policy of attempting it.

In the first place, water transport involves no item of cost equivalent to the wear and tear of rails, sleepers, and fittings, or the maintenance of permanent way, or to the repair of vehicles and locomotives. It is therefore more economical than any other mode of carriage, and it has been estimated that traffic expenses on canals are one-fifth of those on railways, on which this item amounts to 30 per cent. on the expenditure. As calculated by the late Mr Conder, the cost of working the traffic of the railways of the United Kingdom is 0.53d. per ton per mile, which is raised by the addition of 0.78d. per ton per mile, in order to earn interest at 4 per cent. on capital, to 1.31d. per ton per mile, while with a similar volume of traffic the cost of canal transport would be only 0.37d. including 0.11d. for interest—an estimate which appears to be confirmed by the average freights on the Grand Junction, Aire and Calder, Regents, and Gloucester and Berkeley Canals, and on the Thames and the Lea, which he states to be

[1] See a paper on British Canals by Mr W. M. Acworth in the *Economic Journal* for June 1905.

respectively 0.184d., 0.084d., 0.081d., 0.062d., 0.10d., and 0.33d.[1]

In addition to this, the cost of maintenance, which in the case of railways rises and falls with remarkable steadiness with the increase or diminution in the volume of transport, is not only very slightly increased, but also, in some cases, actually reduced by an increase of traffic on canals. The increase in the weight of toll-paying merchandise passing over the Manchester Ship Canal during the first six months of 1902, amounting to nearly 200,000 tons in excess of that for the corresponding period of 1901, when it was 1,391,149 tons, and yielding an increase of £20,095 in revenue, involved an increased expenditure of only £1658; and the annual cost of maintenance per ton per mile of the Suez Canal fell from 0.35d. during 1871-76 to 0.134d. during 1876-81, although the traffic had considerably more than doubled in the latter quinquenium. The cost of haulage is also proportionately diminished by an increase of traffic on canals, a single horse on the Weaver navigation, for example, hauling a cargo of 100 tons which, if increased to 250 or 300 tons only requires two horses; while the superior economy of water transport is also shown in the cost of plant, for while the cost of the locomotive and trucks of a railway train

[1] *Report Select Committee on Canals*, 1883, App. 11, p. 234 *et seq.*, and p. 339 *et seq.*, which contains two important papers by Mr Conder on the subject; Mr Jeans' paper on Comparative Condition and Cost of Transport by Rail and Canal, *Proceedings of Birmingham Conference*, 1895, pp. 19-20; Mr Vernon Harcourt's paper on Inland Navigation, *Journal of Society of Arts*, vol. xlvii., pp. 166-67; and Mr J. A. Saner's paper, "Canals," *Proceedings of Birmingham Conference*, 1895, pp. 61-65.

loaded with 220 tons is £3360, that of a steam barge carrying the same load—which is frequently used to tow three other barges of 260 tons capacity costing £1000 each is only £1600.[1]

Again, any class of goods can be carried by canal in the manner and at the speed most convenient and suitable for it without interfering with other classes. Not only can boats stop anywhere on their journey to land or ship cargo instead of at certain fixed stations, as is necessary on railways, but the boat itself often serves as a warehouse, and the chances of damage to cargo in transit are reduced to a minimum.[2] "Every part of a canal," as was pointed out by Mr Morton, member of a Wolverhampton firm of railway and canal carriers, in his evidence before the Select Committee of 1883, "is in fact a siding, or at least all that is necessary to make it so is to put in a wall and deepen the water for a boat to go alongside."[3] While the capacity for traffic on canals is thus practically unlimited, even in the case of canals with locks (provided they are properly designed), the dead weight to be moved is also much less than in the case of railway carriage. An ordinary railway truck weighs nearly as much as its load, but the cargo boats carry four or five times their own weight; and traction on canals therefore costs half that on the railways of the United Kingdom, on which, according

[1] *The Canal System of England*, by Gordon Thompson, pp. 67-68.

[2] Cf. *Memo. on the policy of Water Carriage in England*, by General Rundall, R.E., *Report Select Committee*, 1883, App. 18, p. 257 *et seq.*

[3] *Ibid.*, Qu. 2623-25, and *cf.* Sir Bartle Frere's evidence, Qu. 2026-27, and *Report Select Committee on Railway Rates and Fares*, Qu. 3451-53, 3603-04.

to the late Mr Conder, it amounts to 16 per cent. of the expenditure.[1]

Lastly, an additional proof of the value of inland water transport is to be found in the results that have attended its development in the United States and on the Continent. The United States, which possess greater natural advantages in this respect than any other country, have devoted as much attention to the development of their waterways as to that of their railways, the State of New York alone having expended some £15,000,000 on canal construction and improvement. Though there are only 51,834 miles of waterway as against 265,352 miles of railway, half a century of competition between the two has made the freight of the United States both by rail and water the cheapest in the world, and in spite of the low amount of the former and the fact that the great through water route between Lake Erie and Lake Superior is closed by ice during four or five months of the year, 27 per cent. of the traffic is water-borne. In the majority of European States the improvement and extension of waterways and railways has been carried on simultaneously by the Government and has been conducted with the object of developing the trade and general prosperity of the country and not, as with us, of promoting the interests of canal and railway companies. In France, the inland navigation system of which country—with an extent of 7617 miles as against 22,663 of railway—has been more fully developed than that of any other European State, and upon which some seventy million sterling has been expended, 30 per cent.

[1] *Report*, 1883, App. 18, p. 257 *et seq.;* and App. 11, p. 234.

of the traffic is water-borne, while 41 per cent. of the total tonnage of goods entering Paris is carried by water. In Germany, which has 6214 miles of waterway as against 23,000 of railway, and which has expended over eighteen millions upon inland navigation, of which £7,800,000 represents the cost of the Kaiser Wilhelm Canal connecting the North Sea with the Baltic, 23 per cent. of the traffic is water-borne, one half of the imports to Berlin being supplied by canal.[1] In Belgium, where the mileage of waterways amounts to half that of the railways—1012 miles as against 2075—the traffic has been so greatly attracted to the former that the State actually at one time incurred an annual loss in working the latter, and silk is carried at one-fourth, and butter, ale, timber, bar and pig iron, and grain are carried at one-half the rates payable in this country.[2] In Italy there are 1290 miles of waterway to 9813 of railway, in Russia, 33,916 miles of waterway to 90,385 of railway, and in Sweden 365 miles of waterway to 7631 of railway. The Dominion of Canada, which has 13,296 miles of railway, has expended 88,000,000 dollars on its waterways which have an extent of 3000 miles; and in British India, which has 26,851 miles of railway, there are, excluding the great rivers, 14,428 miles of irrigation

[1] Germany has, during the present year (1905), decided to expend an additional £16,000,000 on waterways.

[2] Cf. *Report Select Committee on Canals*, App. 10, pp. 232, 238, 240; App. 17, p. 255; App. 18, p. 260; App. 19, p. 262; Papers by Mr Jeans and Mr Wells, *Proceedings of Birmingham Conference*, 1895, pp. 21, 22, 34-39; Paper by Mr Vernon Harcourt, *Journal of Society of Arts*, vol. xlix., pp. 156-63, 167; Gordon Thompson's *Canal System of England*, pp. 59, 65; and article on Inland Navigation already referred to, *London Quarterly Review*, 1886, No. cxxxii., pp. 223-29.

canal, a large proportion of which are fitted with locks and used for navigation, besides some 800 miles of canal constructed solely for that purpose.[1] In all these countries the competition with waterways has had the effect of reducing the freight charges of the railways which, in the United States are 0.40d., in Belgium 0.80d., in Germany 0.82d., in France 1.10d., in Russia 1.20d., and in Italy 1.25d. per ton per mile; while in the United Kingdom, where at the close of the last century they were much lower than on the Continent, they are 1.40d., or 350 per cent. higher than those of the United States, and 75 per cent. higher than those of Belgium.[2]

The large use thus made of waterways by other countries for purposes of transport is in itself a striking proof of the soundness of the other arguments which have been adduced in their favour, and considered in conjunction with them seems completely to outweigh their few disadvantages—namely, the comparatively slow rate of transit upon them; their liability to freeze in winter and thus to disorganise traffic; and the fact that the goods require to be lifted out of the boats, and that special appliances are therefore necessary for discharging cargo. As has been pointed out by Mr Saner in his paper read before the Birmingham Conference on Inland Navigation of 1895,[3] the first and second of these disadvantages can be overcome for all practical

[1] *Cf.* Mulhall's *Dictionary of Statistics;* the Foreign Office List, 1905, p. 118; and as to India, *Report Select Committee on Canals*, 1883, App. 20, pp. 280-86, and India List, 1905, pp. 377, 411, 412.

[2] *Cf.* Mr Wells' paper, *Proceedings of Birmingham Conference*, 1895, p. 34; Mulhall's *Dictionary of Statistics*, p. 796; and App. 11 of *Report Select Committee*, 1883, p. 241.

[3] Cf. *Proceedings*, pp. 51-52.

purposes, during a normal English winter, by the substitution of steam or other power engines for manual and horse power, and by a diminution in the number of locks on waterways and the straightening of their course. The third objection can also easily be met by suitable machinery, and might indeed be urged with almost equal force against railways, the steam canal boat having an advantage over the railway train in being able to carry, as is done on the Weaver, a mast and derrick attached for loading and discharging; and it may therefore be fairly concluded that the Chambers of Commerce of the United Kingdom—bodies which are unlikely to be inspired by mere enthusiasm for a chimerical idea—are fully justified in their persistent advocacy of the resuscitation and development of our inland navigation system.

The principles to be observed in carrying out this development have been clearly indicated in a memorandum on the "Policy of Water Carriage" presented to the Select Committee on Canals 1883[1] by General Rundall, then Inspector General of Irrigation to the Government of India, who groups the various measures necessary for the purpose under the following three heads:—

I. *Improvement in construction*, under which he includes uniformity of gauge in canals and locks, and their adaptation to steam haulage; improvement in the construction of canal boats; and facilities for loading and unloading at important industrial centres;

II. *Amelioration of administration*, under which he includes the regulation of tolls, the establishment

[1] App. 18, p. 250 *et seq.*

and maintenance of through routes, and the formation of a systematic service of boats ;

III. *Controlling supervision*, under which he includes the questions of amalgamation, or control by a central authority.

Though the necessity for carrying out the improvements enumerated under the first of these heads is generally admitted, there appears to be considerable difference of opinion among experts with regard to questions of detail.

Thus, while the principle of uniformity of gauge for all through routes is universally accepted, no definite conclusion has been arrived at with respect to the adoption of a standard of dimensions for all waterways, such as exists in France, where the dimensions are 32½ feet bottom width, 6½ feet depth, and a sectional area of about 297 feet; and in Germany, where the new canals are 46 feet in bottom and 76 feet in top width, and 6½ feet deep with 396.5 feet of sectional area.[1] Various standards were suggested to the Select Committee on Canals 1883, which differed considerably from each other,[2] and a more recent one, which seems well worthy of adoption, was proposed by Mr Saner in a paper read before the Liverpool Engineering Society in which he advocated a canal of 40 feet bottom and 64 feet top width, 8 feet depth of water, and 416 feet of sectional area—dimensions which would accommodate vessels 76 feet long, 18 feet wide, 7 feet deep, and of about 210 tons displacement.[3]

[1] *Cf.* Paper on "Canals" by Mr Saner, *Proceedings Birmingham Conference*, 1895, pp. 53-54.

[2] *Report*, 1883, Morton, Qu. 2649-51 ; Clegram, Qu. 1806, 1815, 1861-62 ; Abernethy, Qu. 1125-27 ; Clark, Qu. 3475.

[3] *Proceedings Birmingham Conference*, p. 53.

Until this question is determined it is obviously impossible to decide that of the probable expenditure on construction necessary to render canals fit to compete with railways, which was estimated by the late Mr Abernethy at £12,000, but by the late Mr Conder and General Rundall at only £5000 to £6000 per mile.[1]

With respect to steam haulage, again, the adaptation of canals for which must necessitate a larger sectional area of waterway, and the thorough protection of the banks, we find Mr Conder and Mr Lloyd advocating before the Committee of 1883 the form in use on the Rhine and on some French canals, where the traffic is drawn upon a steel wire rope laid along the middle of the waterway, the rope being taken over a wheel, and passed through a clip drum, and dropped astern of the tug towing the boats; while Mr Abernethy, on the contrary, was in favour of the ordinary steam haulage as used on some French rivers and Dutch canals.[2] On the Aire and Calder coal is conveyed in floating tanks made up in long trains hauled by a tug; and Mr Bartholomew, the engineer of the canal, calculated that the cost of merchandise towed by tugs carrying cargo is *one thirty-fourth* of a penny per ton per mile, that of merchandise towed by tugs not carrying cargo *one-seventh* of a penny, and that of merchandise conveyed by horse haulage *one-fifth* of a penny per ton per mile.[3] The author of *British Railways and Canals*, a

[1] *Report Select Committee*, 1883, Abernethy, Qu. 1128, 1140, 1144, 1159; Conder, Qu. 2413-16, 2418-19; Rundall, Qu. 3056-57; and *cf.* Sir A. Cotton, App. 21, p. 289.

[2] *Report*, Qu. 2416; 254-66; 1096, 1100, 1160-61.

[3] *Ibid.*, Qu. 897-902, 925-28, 1031-39; and *cf.* Clark, Qu. 3484-86; Morton, Qu. 2617; Rundall, Qu. 3056.

work published in 1885—suggested as a substitute for horse haulage a locomotive and a line of rails on the towing path, and estimated the cost of the line, with a locomotive to every 5 miles of canal, at £1500, and that of each locomotive at £1000, and that a weight of 400 tons could thus be drawn at a speed of 3 miles per hour at 4½d. a mile.[1] Since this suggestion was made, however, electricity has begun to compete with steam, and in his paper on "Transport by Railway and Canal," read before the Birmingham Conference of 1895,[2] Mr Jeans urged the claims of the Cawley-Thwaite system of electrical haulage, and stated that the cost of horse power per twelve hours day for haulage purposes is 1s., as against 1s. 8d. steam tug haulage and horse haulage.

As regards the improvement of canal boats, Mr Lloyd, Mr Conder, and General Rundall, in their evidence before the Select Committee of 1883, all concurred in regarding the narrow boats now in use as conducive to waste in working, and it appears that in some of the manufacturing districts there is sufficient traffic for boats of 200 tons and upwards. Mr Lloyd recommended a length of 110 feet, a width of 11 feet 6 inches, and a depth of 6 feet for a vessel with a carrying capacity of 120 tons, and General Rundall, a length of 150 feet, a breadth of 20 feet, and a draught of about 8 feet for boats of 200 or 300 tons.[3] The maximum total weight carried by the boat trains on the Aire and Calder above alluded to is 900 tons and

[1] Pp. 114-15. The author wrote under the pseudonym of "Hercules."

[2] *Proceedings*, p. 24.

[3] *Report*, Qu. 117-19, 160-61, 223; 2412-14, 2487-89; 3056-59.

the average 700 tons;[1] the ordinary traffic on the Weaver is carried in 250 to 300 ton barges and steamers whose draught is 10 feet and beam 20 to 21 feet amidships;[2] and Mr Marten, Engineer to the Severn Commissioners, stated in his paper read before the Birmingham Conference that some years ago two sea-going steamers, carrying respectively 120 and 140 tons, with a length of 94 feet, a breadth of 19½ feet, and a draught of 7 feet, were built and worked between Worcester and the French and Irish ports. He had also submitted to him by a firm of Glasgow shipbuilders, who undertook to build and fit them out with machinery of sufficient power to drive them, when at sea and loaded, at the rate of nine knots per hour, for the sum of £5600 each, steamers which would comply with the existing conditions of the Severn navigation and carry 290 tons with a 9 feet draught, and would be capable of trading with Ireland and the continental ports.[3]

It will be evident that, with the exception of that relating to uniformity of gauge, which could only be provided for by statute, all the above reforms, as well as a systematic service of boats, which General Rundall includes under the head of "amelioration of administration," might be carried out by the canal companies themselves if they could obtain sufficient financial support from the public to enable them to undertake the task. As regards the other two

[1] *Report*, Bartholomew, Qu. 901-27, 1054-55; and *cf.* on this subject Abernethy, Qu. 1281-83, 1449; Watson, Qu. 1750-51; Thorpe, Qu. 2412-14; Morton, Qu. 2632, 2652-54; and Clark, Qu. 3473-78, 3508-13; Lloyd, App. 2, pp. 206-09; and Sir Arthur Cotton, App. 21, p. 292 *et seq.*

[2] *Cf.* Saner, *Proceedings Birmingham Conference*, 1895, p. 53.

[3] *Proceedings Birmingham Conference*, pp. 91-92.

subjects comprised under this second head, it is, on the other hand, equally clear that legislation is required for dealing both with the regulation of tolls, and also with the establishment and maintenance of through routes, since though there are, as has been shown, some twenty of such routes already in existence they can only be rendered practically effective by making each route uniform in gauge throughout and placing it under a single authority—a process which could only be accomplished by forming a governing body representing the interests of the different canal companies controlling the through route, and by depriving railway companies owning portions of the waterway of its control over them. The settlement of all these questions of improvement of construction and amelioration of administration is however manifestly dependent on that of the fundamental one of *controlling supervision* which forms the last head of General Rundall's memorandum; and it may be pointed out that the first step towards a solution of this problem must be the appointment of a commission of experts to survey the waterways of the United Kingdom in order to ascertain which of them, and especially with regard to through routes, would best repay their maintenance and development; to determine a minimum standard of dimensions for these; and to fix a uniform maximum scale of freight charges for traffic carried upon them. Both our inland navigation system and the resources of our water-supply might be materially benefited by the abandonment of canals which have lost the traffic in bulky goods that rendered them remunerative, on account of the decay of towns situated on their course through rural depopulation and the decline of industries. The

advantages to be derived from making waterways of uniform dimensions are obviously identical with those which have been enjoyed by railway companies since the termination of the "battle of the gauges"; and, apart from the necessity of determining these points for practical purposes, an additional argument in favour of such a survey as has been suggested is to be found in the fact that no system of supervision can be thoroughly effective unless the Central Authority is fully acquainted with the extent and capacity of the system under its control. Assuming however that these preliminaries have been satisfactorily settled by previous inquiry, there are *three* methods, as it appears to us, in which the system of controlling supervision suggested by General Rundall might be established.

As the Board of Trade has, since he wrote, been already constituted a Central Authority for Waterways under the Railway and Canal Traffic Act 1888, the first of these methods which suggests itself for consideration is the extension of the supervisory powers of the Board, with the view of enabling it to develop our inland navigation system through the agency of the existing canal companies and navigation trustees, while preserving, as far as possible, the independent position of the latter. For this purpose the Board should be empowered to require the adoption on all waterways of the standard dimensions and rates of freight charges fixed by the preliminary commission of inquiry; and also to provide for the establishment on each through route of a governing body consisting of representatives of the various companies and trustees controlling the waterways of which it is composed—an arrangement which would facilitate

their ultimate amalgamation. It should also be authorised to direct the compulsory sale to such a governing body of any *links* of canal owned by railway companies, which would thus become the common property of the associated canal companies and trustees; and as its rules with respect to dimensions and freight charges would be applicable to such waterways owned by railway companies as do not form part of any through route, it would be enabled to put an end to the evils at present resulting from the railway monopoly. The provision in sect. 44 of the Act of 1888 for the establishment of a clearing house for canals might be made compulsory instead of permissive; and the enforcement of all the reforms above mentioned might be entrusted to a staff of inspectors of waterways, invested with powers analogous to those of inspectors of coal mines and factories, to whom the functions under sects. 41 and 42 of the Act with respect to canals dangerous to the public might also be entrusted. In order to assist canal companies and navigation trustees to make the necessary improvements in their waterways, and to acquire the railway-owned portions of through routes, it would be necessary that funds should be advanced to them for the purpose, either, as suggested by Mr Clark,[1] one of the witnesses before the Commitee of 1883, by Parliament, or by local authorities; and under these conditions the merits of the various proposals for improvements in steam haulage, boats, etc., mentioned above would be decided by the same process of competition which has taken place with regard to similar points in the case of the railway companies.

[1] *Report*, Qu. 3515-30.

It may be claimed for this scheme that it is a development of existing conditions, and that the success of waterways like the Weaver and the Aire and Calder, in which improvements have been brought up to date, and more especially of the Manchester Ship Canal, coupled with the movement in favour of amalgamation amongst others, affords some grounds for believing that it might prove the means of resuscitating our inland navigation system. It is, however, open to the objection that the more successful companies might be disposed to resist any interference with their present position; that the grant of financial aid to those which would be unable to make the necessary improvements without such assistance from Parliament would be strenuously opposed; and—a point of still greater importance—that experience has shown both the instability of all undertakings dependent in any degree on private enterprise, and also the extreme difficulty of developing any system in which it is a factor on broad lines.

The last-named objection would be fully met by the *second* of the three methods under consideration—namely, the establishment of a Canal Trust as provided for in Mr Barran's Bill, the principles of which have already been sufficiently explained[1]—since it would transfer the control of our waterways from a number of competing bodies to a central authority composed of representatives of all the classes most interested in maintaining them. Though it would no doubt be opposed on the same grounds as the first method—its interference with the rights of private enterprise and the dangers of granting public money for an uncertain object—these objections cannot be regarded as

[1] See *ante*, pp. 258-60.

insuperable, and it may especially be pointed out, with respect to the latter, that the sum required for improving inland navigation would not amount to a tithe of that which has been borrowed by local authorities for experiments in municipal trading of far more questionable value. Its most serious defects appear to be that, as the operations of the proposed Trust would be limited to one or two groups of waterways and extended, so to speak, piecemeal, it seems to be even less calculated than the proposed improvement of the existing system of supervision under the Board of Trade, to promote the development of our inland navigation system as a whole; and that the size of the governing body, which would be increased as the system extended, would seriously impair its efficiency as a Central Authority for the whole kingdom. Like the Conservators of the Thames and the London Water Board, the Canal Trust would, moreover, be a *quasi* Government Department, and its establishment would therefore be merely a partial adoption in another and less effective form of the principle of the third, and from an administrative point of view, in our opinion, the best of the proposed methods of organising supervisory control—the Nationalisation of Waterways.

Though it must be admitted that while the large outlay it would at first entail must prove a serious obstacle to the initiation of such a system of Nationalisation, this primary expenditure — which might be met by the Government inviting a loan for the purpose of purchasing the canals—would speedily be amply repaid by the immense incentive given to commercial enterprise. Not only would facilities for trade be largely increased by doubling our means of

communication, but, to quote General Rundall, whose remarks are as fully applicable now as when they were written twenty-two years ago, "a profitable opening would be possible for the disposal of some of the large amount of capital now seeking investment, and a new and additional field of employment would be opened to the labouring and industrial classes who are now struggling to obtain even a bare subsistence for themselves and their families."[1] Abundant evidence has been given in the preceding chapter to show that canals, even in their present condition, can be made remunerative, and, in view of this fact, there is every reason for accepting the statement of another authority on Indian irrigation, the late Sir Arthur Cotton, that "had a hundredth part of the thought that has been applied to land carriage been brought to bear on internal water carriage, England would have benefited to the extent of £4,000,000 or £5,000,000 a year,"[2] and for believing that if a similar amount of attention is bestowed on them now it will produce corresponding results.

If therefore it be admitted that the advantages to be derived from it would abundantly compensate the nation for any expenditure it might involve, there is no argument which can, with any plausibility, be advanced against the nationalisation of our inland navigation system. It was strongly advocated before the Select Committee of 1883 by Mr Lloyd,[3] and by Mr Abernethy,[4] and also, though with somewhat more hesitation, by Mr Conder,[5]

[1] *Report of Select Committee*, 1883, App. 18, p. 261.
[2] *Report*, App. 21, p. 290. [3] *Ibid.*, Qu. 659-60.
[4] *Ibid.*, Qu. 1237, 1245, 1340-41.
[5] *Ibid.*, Qu. 2453-55, 2459, 2464, 2471-72.

Mr Vernon Harcourt,[1] and General Rundall;[2] while, as has been shown,[3] the recent proposals for its adoption made by the Associated Chambers of Commerce were only abandoned in favour of those for establishing a Canal Trust on account of the difficulty of persuading Parliament to provide the funds necessary for carrying it out. The ownership of canals by the State has produced successful results in India and throughout the Continent of Europe, and it is therefore hard to see why it should not prove equally successful in the United Kingdom where the Government—which already owns the Caledonian and Crinan Canals in Scotland, and various waterways in Ireland—earns a handsome revenue from its management of the Post-office, Telegraphs and Telephones, and encourages Municipalities to undertake that of Tramways, Gas, and Water-supply. The internal communications of a country, whether by water, rail, or road, which traverse it from one extremity to another unimpeded by county, municipal, or parish boundaries, can only be efficiently managed on national lines; and the inadequacy of our inland navigation system, like that of our highway system, is largely due to the tendency to regard all such questions from what may be termed a parochial rather than the national point of view.[4]

Lastly, the maintenance and development of our inland navigation system is, as was pointed out in the opening chapters of this work,[5] only one branch

[1] *Report*, Qu. 2606, 2613.

[2] *Ibid.*, Qu. 3056, 3073, 3085, App. 18, p. 251 *et seq.*

[3] See *ante*, pp. 255-56.

[4] *Cf.* General Rundall, *Report Select Committee*, 1883, App. 18, p. 261.

[5] *Cf.* Chap. i., pp. 4-8, chap. ii., p. 10, chap iii., pp. 23, 28-35.

of the science of water conservancy, and cannot be effectively dealt with without taking into consideration the kindred branch of water-supply, upon which that system is as much dependent as are the reservoirs of our water companies, and the wells and ponds of our villages. Hitherto the sources of this supply have been—like our forests, the open country adjoining our towns, and the shingle beaches which protect our coasts from the sea—freely and unsystematically utilised as if they were inexhaustible, without any regard to the increasing demands upon them arising from the growth and changed habits of our population. The Report of the Salmon Fisheries Commission, 1902, shows that the indiscriminate selection of their sources of supply by water companies and municipalities, and the reckless waste of water through mining operations, have seriously diminished the volume of our rivers and dried up many of the springs and wells which furnish our rural water-supply and feed our canals.[1] It has been estimated by General Rundall that only 5 per cent. of the water that falls in these islands is utilised;[2] and no attempt has ever been made to provide, as has often been suggested, for the storage of any of the vast quantity of water allowed to run to waste during each of the floods which periodically inundate large tracks of riparian land throughout the country, and entail a pecuniary loss to the owners of property amounting, probably, in many cases to double the sum required for the construction of reservoirs and other works which would permanently prevent its

[1] *Report*, pp. 12, 49, 51, 61.

[2] *Report Select Committee on Canals*, 1883, App. 18, p. 261.

occurrence.[1] It is therefore important, in considering the nationalisation of waterways, to bear in mind the valuable recommendations made by the Salmon Fisheries Commission, 1902, in the report just referred to, namely, that a Central Water Authority with subordinate boards for each watershed area should be established for controlling salmon fisheries and preventing the pollution of, and injurious abstraction of water from rivers; and that for this purpose a preliminary survey and estimate of the water-supplies available on all watersheds throughout the kingdom should be made for the use of such boards. Such a system would obviously be as valuable for the purposes of the conservancy of navigation as for those of fishery and water-supply for domestic and industrial purposes, since, though with regard to traffic, waterways are more conveniently grouped according to the lines of communication they furnish between the chief ports and industrial centres of the kingdom, each canal and river navigation is dependent for its sources of supply upon its situation in one of the watershed areas which it is proposed to place under the control of subordinate boards. If therefore the proposed Central Authority, which would presumably be a Government Department presided over by a member of the Ministry, were,

[1] During the floods in the valley of the Huntingdonshire Ouse in October 1880, for example, the loss to occupiers of land was, according to a memorial presented to Mr Gladstone by the Mayor and Corporation of St Ives, estimated at £200,000, and it was stated that the annual produce of 30,000 acres of fine meat-producing corn and garden land was frequently destroyed by the overflowing of the river; and it would be easy to cite numerous similar instances of damage caused by the floods both of preceding and recent years.

in addition to its other functions, entrusted with the duty of maintaining and developing our waterways after their acquisition by the State, it would possess all the powers necessary for the establishment of a system of water conservancy in the fullest sense of the term—"the scientific treatment and regulation of all the water received in these islands from its first arrival in the form of dew or rain till its final disappearance in the ocean." [1]

[1] Mr Edward Easton, C.E., in his presidential address to the Mechanical Section at the meeting of the British Association at Dublin, 1878. *Proceedings*, vol. xlviii., p. 679; and *cf.* article above referred to in *London Quarterly Review*, 1883, on River Conservancy, No. cxix., p. 31.

APPENDIX I

A.—THE PRINCIPAL RIVERS AND LAKES OF ENGLAND AND WALES

(i) THE PRINCIPAL RIVERS OF ENGLAND AND WALES

Extracted from Appendix B of the *Report of the Select Committee of the House of Lords on Conservancy Boards*, 1877, pp. 282-6. The list was compiled by Mr Grantham, M.I.C.E., whose evidence will be found at p. 87 *et seq.* of the Report. *Cf.* App. II. *post.*

I

First-class Rivers having Catchment Basins of 1000 Square Miles and upwards[1]

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
1. Humber .	York . .	37	1229	2	55
2. Mersey .	Lancaster .	68	1707	6	188
3. Nen . .	Northants .	99	1055	1	11
4. Ouse . .	York . .	59½	4207	11	629
5. Ouse . .	Camb. and Beds	156¼	2894	8	212
6. Severn .	Glo'ster . .	178	4437	17	450
7. Thames .	Glo'ster . .	201½	5162	15	463
8. Trent. .	Lincoln . .	167½	3543	10	293
9. Tyne . .	Northumb'land	35	1053	6	154
10. Witham .	Lincoln . .	89	1052	4	75
11. Wye . .	Hereford . .	148	1655	9	223

[1] Of these eleven rivers, the catchment basin of one—the Thames—exceeds 5000 square miles; two exceed 4000; one exceeds 3000; one exceeds 2000; and six exceed 1000.

II

Second-class Rivers having Catchment Basins of from 500 to 1000 Square Miles. (*See Note at end of Table.*)

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
1. Avon . .	Somerset . .	78½	869	4	59
2. Avon . .	Hants . .	67	666	1	28¼
3. Dee . .	Flint . .	93	850	4	82

SECOND-CLASS RIVERS—*continued*

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
4. Eden . .	Cumberland .	79½	916	4	97½
5. Exe . .	Devon . .	58½	562	5	81¼
6. Medway .	Kent . .	69	997	3	62½
7. Parrett .	Somerset . .	38½	561	4	106
8. Ribble .	Lancaster .	61	501	4	90¾
9. Tees . .	York . .	95	744	9	132
10. Test . .	Hants . .	35¼	544	1	6¾
11. Towy. .	Carmarthen .	66½	522	3	55
12. Usk . .	Mon. . .	76½	650	7	107
13. Welland .	Northants .	72½	707	3	78
14. Yare . .	Norfolk . .	35	553	4	84

The catchment basin of two of these rivers exceeds 900 square miles; of two, 800; of two, 700; of two, 600; and of six, 500.

III

THIRD-CLASS RIVERS HAVING CATCHMENT BASINS OF FROM 100 TO 500 SQUARE MILES. (*See Note at end of Table.*)

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
1. Arun . .	Sussex . .	51½	349	...	...
2. Adur . .	Sussex . .	21	147	...	...
3. Alde . .	Suffolk . .	30¾	127	1	8
4. Alt . .	Lancaster. .	16½	170	...	...
5. Aln . .	Northumb'land.	24	102	...	...
6. Axe . .	Devon . .	25¼	155	1	14½
7. Blackwater	Essex . .	50	465	2	53
8. Brue . .	Somerset . .	36¼	197	...	...
9. Bure . .	Norfolk . .	52¼	338	1	11¼
10. Camel .	Cornwall . .	28¼	155	1	8¼
11. Cleddau,W.	Pembroke .	24½	116	...	...
12. Colne. .	Essex . .	37¾	200	1	13¼
13. Conway .	Carnarvon .	30¼	224	3	29¾
14. Coquet .	Northumb'land.	45	213	...	...
15. Crouch .	Essex . .	20½	150	1	13¼
16. Dart . .	Devon . .	37¼	179	1	10½
17. Deben .	Suffolk . .	32	159	1	10
18. Derwent .	Cumberland .	35¼	268	1	13½
19. Derwent .	Derby . .	64¼	429	3	37
20. Dovey .	Montgomery .	35	264	5	44½

THIRD-CLASS RIVERS—*continued*

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
21. Duddon .	Cumberland .	27¼	117	...	...
22. Elwy . .	Denbigh . .	31½	306	3	49¾
23. Esk . .	Cumberland .	8¼	143	2	35
24. Esk . .	York . .	29½	136	3	25
25. Fal . .	Cornwall . .	30½	118	1	9¼
26. Fowey .	Cornwall . .	27	116	1	6¼
27. Frome .	Dorset . .	34	206	1	7¾
28. Glaslyn .	Carnarvon .	18½	142	1	14¾
29. Itchen .	Hants . .	27¼	137	...	...
30. Kent . .	Cumberland .	28½	196	4	49
31. Leven .	Lancaster .	6½	123	3	25
32. Llwchwr .	Carmarthen .	22½	130	5	45
33. Lune . .	Lancaster .	53½	434	3	41¼
34. Mawddach .	Merioneth .	21¼	147	3	26¼
35. Neath .	Glamorgan .	24½	121	3	23½
36. Ogmore .	Glamorgan .	15¾	111	3	27¾
37. Orwell .	Suffolk . .	35	257	...	...
38. Ouse . .	Sussex . .	34¼	212	...	...
39. Portsmouth and Chichester Basin	Sussex . .	...	315	...	...
40. Rother .	Sussex . .	33½	281	...	...
41. Steeping .	Lincoln . .	24	102	...	...
42. Stour . .	Essex . .	61¾	420	2	34
43. Stour (Gt.).	Kent . .	52¾	291	1	12
44. Stour . .	Dorset . .	64	479	2	25
45. Taf . .	Carmarthen .	31¾	187	2	27
46. Taf . .	Glamorgan .	38¼	202	6	59¼
47. Tamar .	Cornwall . .	35¾	381	2	32
48. Towy . .	Glamorgan .	27¼	110	1	10½
49. Teign .	Devon . .	34½	189	...	...
50. Titchfield .	Hants . .	20¾	128	...	...
51. Torridge .	Devon . .	52½	349	2	30
52. Trent . .	Dorset . .	21½	125	...	...
53. Tweed .	Northumb'land.	22	267	1	30
54. Wansbeck .	Northumb'land.	27	183	2	27½
55. Waveney .	Norfolk . .	58¾	339	...	...
56. Wear . .	Durham . .	70	455	6	76¾
57. Wyre . .	Lancaster .	35¼	179	2	20¼
58. Yeo . .	Somerset . .	14¼	127	...	...

Of these rivers, six have catchment basins of from 400 to 500 square miles; eight of from 300 to 400; twelve of from 200 to 300; and thirty-three of from 100 to 200.

IV

Fourth-class Rivers having Catchment Basins of from 50 to 100 Square Miles

Name.	County.	Length in Miles.	Area of Basin, sq. miles.	Tributaries.	
				Number.	Length (united).
1. Aeron .	Cardigan . .	19½	63	...	...
2. Avon . .	Devon . .	23¼	55	...	...
3. Ax . .	Somerset . .	24	98	...	...
4. Blyth . .	Northumb'land.	26½	80	1	19¼
5. Blythe .	Suffolk . .	18¼	71	...	...
6. Cleddau (E.)	Pembroke .	19½	80	1	12¾
7. Cuckmere .	Sussex . .	24	75	...	...
8. Duncleddau	Pembroke .	11	76	...	...
9. Dysynni .	Merioneth .	14	64	...	...
10. Ehen . .	Cumberland .	14½	59	...	...
11. Ellen . .	Cumberland .	20¾	54	...	...
12. Ereh . .	Carnarvon .	12	53	...	...
13. Germain, St	Cornwall . .	8	95	2	35½
14. Lac or Ely .	Glamorgan .	24	64	...	...
15. Line Water	Northumb'land.	15½	50	...	...
16. Otter . .	Devon . .	27	95	...	...
17. Plym . .	Devon . .	15	73	...	...
18. Rheidol .	Cardigan . .	25½	74	2	32
19. Rumney .	Glamorgan .	35½	99	1	7
20. Tavey .	Devon . .	23	87	1	12
21. Taw . .	Devon . .	48¾	77	3	49½
22. Wampool .	Cumberland .	18	62	1	8
23. Withern .	Lincoln . .	20¼	91	...	...
24. Ystwyth .	Cardigan . .	23¼	75	...	...

V

Fifth-class Rivers having Catchment Basins of from 10 to 50 Square Miles

This class contains 143 rivers, the length of which varies from 19¼ miles—Tetney Drain, in Lincolnshire, the basin of which has an area of 44 square miles—to 2 miles (the Sillybrook, in Glamorganshire, the basin of which has an area of 19 square miles); and 22 of them are apparently nameless, as they are described simply as streams.

(ii) PRINCIPAL LAKES IN ENGLAND AND WALES

English Lakes

From Stanford's *Compendium of Geography and Travel*, vol. x., p. 197; and *cf.* "Bathymetrical Survey of the English Lakes," by Dr R. H. Mill, F.R.S.E., *Geographical Journal*, vol. vi., pp. 46-73, and 133-66.

Name.	Length.		Breadth (Yards).		Area.
	Miles.	Chains.	Max.	Mean.	Sq. Miles.
Windermere . .	10	50	1610	950	5·69
Ullswater. . .	7	35	1100	827	3·44
Wastwater . .	3	...	880	650	1·12
Coniston Water .	5	41	870	600	1·89
Crummock Water .	2	50	1000	700	0·97
Ennerdale Water .	2	40	1000	800	1·12
Bassenthwaite Water	3	83	1300	950	2·06
Derwent Water .	2	87	2130	1270	2·06
Hawes Water . .	2	33	600	450	0·54
Buttermere . .	1	26	670	620	0·36
Thirlmere . .	2	93	625	270	0·51

Welsh Lakes

From a paper by Mr T. J. Jehu, M.D., B.Sc., F.G.S., in the *Transactions of the Royal Society of Edinburgh*, 1901-2, vol. xl., pp. 419-67.

Name.	Length.	Breadth (Yards).		Area.
	Yards.	Max.	Mean.	Sq. Yards.
Llyn Gwynant . .	1540	515	354	545,800
Llyn Dinas . . .	1240	420	300	371,930
Llyn Idwal . . .	846	340	188	159,300
Llyn Crafnant . .	1390	320	214	297,300
Llyn Padarn. . .	3530	595	380	1,340,800
Llyn Peris . . .	1930	500	310	398,720
Llyn Llydaw. . .	1950	460	301	587,200
Llyn Glaslyn . .	535	275	197	105,600
Llyn Cwellyn . .	2120	665	505	1,069,600
Llyn Ogwin . . .	1700	415	268	456,400
Llyn Cawlyd. . .	2855	495	335	957,800
Llynian Mymbr { Upper Lake .	760	412	291	221,520
Llynian Mymbr { Lower Lake .	880	330	198	174,000
Llyn Eigian . . .	1690	520	255	431,200
Llyn Geirionydd . .	1348	356	221	297,600
Llyn Dulyn . . .	560	380	297	166,520

B.—THE PRINCIPAL RIVERS AND LAKES OF SCOTLAND

(i) PRINCIPAL RIVERS AND STREAMS OF SCOTLAND

Extracted from Groome's *Ordnance Gazetteer of Scotland*, new edition, vol. iii., p. 515.

Name.	Area of Basin in sq. miles.			Length of Course in miles.
Tay	2400			119⅜
		Tributaries	Bran	19
			Almond	30
			Earn	46¼
			Lyon	34¼
			Tummel	29
			Garry	22
			Tilt	15⅜
			Isla	37
Tweed	1870			97
		Tributaries	Ettrick	32⅝
			Yarrow	14½
			Teviot	37¼
			Jed	21¾
			Till	40
			Bowmont	20
			Lyne	18¾
			Eddleston	9
			Gala Water	21
			Lauder or Leader	21¼
			Whiteadder	34
Clyde	1480			106
		Tributaries	Medwin	15
			Calder	10
			Kelvin	21
			Leven	7¼
			Douglas	20
			Avon	24¼
			Cart	19
			Irvine	29½
			Annick	16
			Garnock	21⅛
			Cessnock	14
Spey	1190			96
		Tribs.	Avon	27¾
			Dulnain	28
Dee (Aberdeenshire)	700			87⅛

(i) PRINCIPAL RIVERS AND STREAMS OF SCOTLAND—*continued*

Name.	Area of Basin in sq. miles.		Length of Course in miles.
Forth	645		$116\frac{1}{2}$
		Tributaries Bannock Burn	14
		Carron	20
		Leith, Water of	24
		South Esk	23
		North Esk	17
		Teith	34
		Allan	20
		Devon	$33\frac{3}{4}$
		Leven	16
		Ore	17
Don	530		$82\frac{1}{4}$
		Trib. Ury	18
Beauly	324		40
		Tribs. Cannich	24
		Farrer	$27\frac{1}{2}$
Oikell	300		$35\frac{1}{4}$
		Tribs. Carron	9
		Shin	$7\frac{5}{8}$

Lesser Rivers

Name.	Length.
Nith	$70\frac{3}{4}$
Tribs. Scar	$18\frac{3}{8}$
Cluden	23
Annan	49
Tribs. Evan	$16\frac{1}{4}$
Ae	16
Moffat Water	14
Milk Water	$17\frac{3}{4}$
Esk	$36\frac{3}{4}$
Tribs. Ewes	$11\frac{3}{4}$
Tarras	11
Liddel	$26\frac{3}{4}$
North Esk	$48\frac{3}{4}$
Dee (Kirkcudbright)	$38\frac{1}{2}$
Trib. Ken	$28\frac{1}{2}$

Name.	Length.
Ayr	38
Trib. Lugar	$12\frac{1}{2}$
Eden	$29\frac{1}{2}$
South Esk	29
Doon	$26\frac{1}{2}$
Findhorn	$62\frac{1}{4}$
Deveron	$61\frac{5}{8}$
Nairn	38
Ythan	$35\frac{1}{8}$
Helmsdale	$27\frac{1}{2}$
Thurso	27
Naver	$18\frac{7}{8}$
Conan	$12\frac{1}{4}$

(ii) PRINCIPAL LAKES IN SCOTLAND[1]

Name.	Length.	Breadth.	Area.
	Miles.		Acres.
Lomond . . .	22	5 miles	17,420
Ness . . .	22½	1 mile	12,355
Awe . . .	22¾	3 furlongs to 3¼ miles	9,995
Maree . . .	12⅜	3 furlongs to 2½ miles	7,090
Tay . . .	14½	1⅛ miles	6,550
Shiel . . .	17½	1 mile	4,880
Leven . . .	3⅝	2 miles	3,406
Katrine . . .	8	7¼ furlongs	3,119
Archaig . . .	12	¾ mile	3,976
Fion or Fuir . .	5⅜	½ furlong to 1¼ miles	2,238
Earn . . .	6¾	6 furlongs	2,118
Loyal (Laoghal) .	4⅜	7 furlongs	1,623
Naver . . .	6¼	4¼ furlongs	1,444

[1] *Cf.* "Bathymetrical Survey of the Freshwater Lochs," by Sir J. Murray and L. Puller, *Geographical Journal*, vol. xxii., pp. 23, 521; and Groome's *Ordnance Gazetteer of Scotland*, vol. iii.

Lesser Lakes

Name.	Length.	Breadth.
	Miles.	
Ericht	14¾	¼ mile to 9 furlongs
Fannich	6⅜	3 to 7 furlongs
Ken	4½	200 to 800 yards
Lochy	9⅝	1 to 9¾ furlongs
Lydock	5¼	½ mile maximum
Monar	4¼	3¾ furlongs
Rannoch	9⅜	2 to 9 furlongs
Shin	17½	¼ to 1½ miles
Stenness	4¾	1¾ miles maximum

C.—THE PRINCIPAL RIVERS AND LAKES OF IRELAND

Compiled from Ordnance Survey Map of Irish Rivers and their Catchment Basins, 1867-68, which also supplies particulars with respect to the Irish lakes. The total number of rivers enumerated in the reference table at the foot of this map is 237, exclusive of the smaller tributaries, which are not numbered, but of which there are about 135, the Shannon alone having 53. *Cf.*, too, Cassell's *Gazetteer of Great Britain and Ireland*, and Sir Robert Kane's *Industrial Resources of Ireland.*

(i) PRINCIPAL RIVERS

(*a*) Rivers having Catchment Basins of 1000 Square Miles and Upwards

Name.	Principal Tributaries.	Area of Basin in Square Miles.	Length in Miles.
1. Bann[1] . .	...	937¾	85½
	1. Main . .	277½	34¼
	2. Moyola . .	129¼ } 2092½	30¾ } 235½
	3. Ballinderry .	166	28¼
	4. Blackwater . (Co. Tyrone and Armagh)	582	56¾
2. Barrow[2] . .	...	1118½	119½
	1. Suir . .	1394 } 3489½	114½ } 321¼
	2. Nore . .	977	87¼
3. Blackwater[3] . (Co. Cork and Kerry)	...	1284½	104½
4. Boyne[4] . .	...	1040¼	70
5. Corrib[5] . .	...	1211¼	5¾
6. Erne[6] . .	...	1688¾	64¼
7. Shannon[7] .	...	4553¾	160½
	1. Suck . .	617½	82½
	2. Inny . .	486½ } 6060	55½ } 335
	3. Fergus . .	402¼	36½

[1] Lough Neagh (area of catchment basin 150 square miles) is also included in this basin.
[2] The Barrow has 29 lesser tributaries.
[3] 11 tributaries.
[4] 15 tributaries.
[5] 11 tributaries. The catchment area also includes Loughs Corrib and Mask.
[6] 15 tributaries. The catchment area also includes Loughs Erne, Macnean, Oughter, Gowna, and Garradin.
[7] The Shannon has 53 lesser tributaries, and its catchment basin comprises also Loughs Derg, Ree, Forbes, Boffin, Key, Boderg, Gara, Allan, Ennell, Owel, Iron, Derraveragh, and Sheelin.

(i) PRINCIPAL RIVERS—*continued*

(*b*) Lesser Rivers having Catchment Basins of 50 Square Miles and Upwards

Name.	Area of Catchment Basin in Square Miles.	Length in Miles.
1. Argideen	56½	17¾
2. Ballynahinch	67¾	18½
3. Ballysadare	251¾	5½
4. Bandon	234¾	45
5. Broad Meadow Water	69	21
6. Bush	130	33
7. Caragh	63¾	19
8. Castletown	97½	28
9. Cloonaghmore	51	19¾
10. Corrock	53¾	14½
11. Dea	151¼	37¾
12. Dombey	51¾	25¼
13. Drowes	102¼	4½
14. Erriff	68¼	20¼
15. Fane	135	38¼
16. Faughan	114¾	29¼
17. Feale	445½	46
18. Finn	195	39¼
19. Foyle	212½	72¾
20. Garogue	139½	3½
21. Glashaboy	58	15
22. Glyde	134½	34¼
23. Gweebara	60	19¾
24. Ilen	116¼	20¼
25. Inagh	100½	23¼
26. Kilcolgan	148½	91¼
27. Kinvara	168½	91¼
28. Lagan	218	53¼
29. Laney	320	14
30. Leannan	108¼	28¼
31. Lee	483¼	55½
32. Liffey	528	82
33. Maine	154	26
34. Mourne	121	9½
35. Moy	805½	62½
36. Nanny	95	24
37. Newport	56	18¼
38. Newry	119	27
39. Owencarron	65	13¼
40. Owenvorragh	62½	18
41. Owenboy	55	20½
42. Owenduff	51½	17¼

(*b*) Lesser Rivers—*continued*

Name.	Area of Catchment Basin in Square Miles.	Length in Miles.
43. Owenmore	130	29¼
44. Ovoca	251¼	9½
45. Quoile	98	27¼
46. Roe	150¼	34¼
47. Slaney	680¼	73
48. Swilly	111¾	25½
49. Tolka	56¼	20¼
50. Womanagh	58¾	19

(ii) PRINCIPAL LAKES

(*a*) Lakes with an Area of 15,000 Acres and Upwards

Name.	Catchment Basin in which situated.		Length in Miles.	Width in Miles.	Area in Acres.
	Name of River.	Area in Square Miles.			
1. Conn and 2. Cullen	Moy	805½	9½ / 3	...	15,600[1]
3. Corrib	Corrib	1211	28½	6 max.	43,484
4. Derg	Shannon	6060	24	2 „	29,570
5. Erne, Upper / „ Lower	Erne	1688¾	14½ / 21¼	4½ „ / 2⅝ „	37,278
6. Mask	Corrib	1211	15	4½ „	22,219
7. Neagh	Bann	2242½	14	6 to 8	98,235

[1] The coast-line is 53 miles.

(*b*) Lesser Lakes

Name.	Catchment Basin in which situated.		Length in Miles.	Width in Miles.	Area in Acres.
	Name of River.	Area in Square Miles.			
1. Allan[1]	Shannon	6060	7¾	1 to 4	5120
2. Arrow	Ballynadare	2514	5¼	...	3010
3. Boderg	Shannon	6060	7¼	...	...
4. Boffin	Shannon	6060	1½	...	...
5. Caragh	Caragh	65¼	4½	...	...

[1] The Allan and the other loughs in the catchment basin of the Shannon are practically extensions of that river.

(*b*) Lesser Lakes—*continued*

Name.	Catchment Basin in which situated.		Length in Miles.	Width in Miles.	Area in Acres.
	Name of River.	Area in Square Miles.			
6. Currane	Cummeragh	$45\frac{1}{4}$	$3\frac{3}{4}$	...	...
7. Derriana	Cummeragh	$45\frac{1}{4}$	$1\frac{3}{4}$	...	...
8. Derravaragh	Shannon	6060	$6\frac{1}{4}$	...	2250
9. Ennell	Shannon	6060	$4\frac{3}{4}$	...	...
10. Forbes	Shannon	6060	$2\frac{1}{4}$	...	...
11. Gara	Shannon	6060	$7\frac{1}{4}$	4 max.	3683
12. Garadice	Erne	$1688\frac{3}{4}$	3	...	...
13. Gill	Garogue	$139\frac{1}{2}$	$5\frac{1}{2}$	$1\frac{3}{4}$ max.	3030
14. Gowna	Erne	$1688\frac{3}{4}$	$6\frac{3}{4}$	...	...
15. Inagh	Ballynahinch	$67\frac{3}{4}$	3	...	...
16. Iron	Shannon	6060	$2\frac{3}{4}$	$1\frac{1}{2}$ max.	...
17. Key	Shannon	6060	$3\frac{1}{4}$	$2\frac{1}{2}$,,	...
18. Killarney—					
Upper Lough	Laune	320	$2\frac{1}{2}$	$\frac{3}{4}$,,	430 } 6111
Muckross	Laune	320	2	1 ,,	680 } 6111
Lough Cane	Laune	320	5	$2\frac{1}{2}$,,	5001 } 6111
19. Lene	Boyne	1040	$2\frac{3}{4}$	1 ,,	...
20. Macnean	Erne	$1688\frac{3}{4}$	$\frac{3}{4}$	...	...
21. Melvin	Drowes	$102\frac{1}{2}$	$7\frac{1}{4}$	$1\frac{1}{2}$ max.	...
22. Oughter	Erne	$1688\frac{3}{4}$	4	3 ,,	...
23. Owell	Shannon	6060	$3\frac{3}{4}$	...	...
24. Ramor	Boyne	1040	$4\frac{3}{4}$	1 ,,	...
25. Ree	Shannon	6060	$17\frac{1}{2}$	3 to 5	...
26. Sheelin	Shannon	6060	$4\frac{3}{4}$	2	...

APPENDIX II

I.—ALPHABETICAL LIST OF CANALS AND RIVER NAVIGATIONS IN THE UNITED KINGDOM

Compiled from the Returns made to the Board of Trade, under section 39, sub-section 2, of the Railway Traffic Act, 1888, for the year 1898, pp. 7-10 ; from the Map of Mr Lionel D. Wells, M.I.C.E. ; as regards Ireland, from the Report of Lord Monck's Commission, 1882 ; and from the Lists supplied by Messrs Lloyd and Taunton in Appendices II. and VII. of the Report of the Select Committee on Canals, 1883.

In the following tables, C = Canal ; N = River Navigation.

ENGLAND AND WALES

No. on Map.	Name.	Railway Controlled.		Owners.	Independent.	
		Miles.	Chains.		Miles.	Chains.
92	C Aberdare	...	...	...	6	60
13	N Aire and Calder	...	...	...	85	20
24	N Ancholme	...	...	...	19	10
111	N Adur	...	...	...	14	...
112	N Arun	...	...	...	32	...
118	N Axe	...	...	...	9	...
56	C Ashby-de-la-Zouch	30	...	Midland Railway Co.	...	...
18	C Ashton and Oldham	17	12	Great Central Railway Co.	...	...

ENGLAND AND WALES—*continued*

No. on Map.		Name.	Railway Controlled. Miles.	Railway Controlled. Chains.	Owners.	Independent. Miles.	Independent. Chains.
104	N	Avon, Somerset	11	...	Great Western Railway Co.	...	...
	C	Basingstoke	...	...	*See Woking, Aldershot, and Basingstoke.*		
12	N	Beverley Beck	...	...	...	...	67
58	C	Birmingham	...	...	...	158	70
	C	Birmingham and Liverpool	...	...	*See Shropshire Union.*		
80	C	Birmingham and Warwick Junction	...	...	...	2	50
67	N	Blyth	...	...	...	9	...
	N	Bourne Eare	...	...	...	3	4
14	C	Bradford	...	...	...	2	40
51	C	Brandon	...	...	...	14	...
89	C	Brecon and Abergavenny	33	69	Great Western Railway Co.	...	...
123	C	Bridgwater and Taunton	14	40	Great Western Railway Co.	...	...
	C	Bridgwater	...	...	*See Manchester Ship Canal.*		
128	C	Bude	...	...	...	2	...
63	N	Bure	...	...	*See Great Yarmouth.*		
25	C	Caistor	...	...	...	4	...
15	N	Calder and Hebble	...	...	...	27	23
105	N	Canterbury	...	...	...	20	...
51	N	Cam River	...	...	*See Ouse (Bedford).*		
71	N	Chelmer and Blackwater	...	...	...	13	7
35	C	Chester	...	...	*See Shropshire Union.*		
29	C	Chesterfield	46	...	Great Central Railway Co.	...	...
115	C	Chichester	...	...	...	4	20
70	N	Colne	...	...	...	4	40

57	C	Coventry	...	...	...	32	40
43	C	Cromford and Langley Mill	14	53	Midland Railway Co.	...	...
136	N	Dee[1]	...	...	...	10	...
46	C	Derby	...	...	...	18	20
7	N	Derwent	40	...	N.-E. Railway Co.	...	...
22	N	Don	...	...	*See Sheffield & South Yorkshire.*		
10	C	Driffield	...	...	...	6	55
81	C	Droitwich Junction	...	See	*Sharpness Docks Navigation.*		
81	C	Droitwich					
35	C	Ellesmere	...	...	*See Shropshire Union.*		
44	C	Erewash	...	...	...	11	60
125	C	Exeter (Ship)	...	...	...	5	60
4	N	Foss	...	...	...	1	38
27	C	Fossdyke	10	63	G. N. and G. E. Railway Co.	...	...
68	N	Gippen	16	...	G. E. Railway Co.	...	...
91	C	Glamorganshire	...	...	...	25	20
39	N	Glen	...	...	...	3	40
100	C	Gloucester and Berkeley (Ship)	...	See	*Sharpness Docks Navigation.*		
76	C	Grand Junction, including Grand Union and Leicester and Northants Union	...	...	...	188	51½
123	C	Grand Western	10	60	Great Western Railway Co.	...	...
41	C	Grantham	33	9	G. N. Railway Co.	...	...
108	C	Gravesend and Rochester	4	...	S. E. Railway Co.	...	...
	N	Great Yarmouth	...	...	...	110	...
		Comprising— Miles.					
63		Rivers: Bure 63					
66		Rivers: Waveney 23					
64		Rivers: Yare 24					
17	C	Huddersfield	23	49	London and N.-W. Railway Co.	...	...

[1] *Tidal* only.

ENGLAND AND WALES—*continued*

No. on Map.	Name.	Railway Controlled. Miles.	Railway Controlled. Chains.	Owners.	Independent. Miles.	Independent. Chains.
28	N Idle	...	...	...	10	...
120A	C Ilchester	...	...	...	7	...
68A	C Ipswich and Stowmarket	...	...	...	15	70
116	N Itchen	...	...	...	14	...
	N Ivel	...	...	...	11	...
102	N Kennet	18	40	Great Western Railway Co.	...	...
102	C Kennet and Avon	57	...	Great Western Railway Co.	...	...
75A	C Kensington	...	32	W. Lon. Exten. Railway Co.	...	...
3	C Lancaster	59	51	Lon. and N.-W. Railway Co.	...	...
51	N Larke	...	...	...	16	20
43	C Lea Wood Branch	...	$24\frac{3}{4}$	Midland Railway Co.	...	...
73	N Lea	...	...	...	28	...
14	C Leeds and Liverpool	...	...	...	141	60
49	N Leicester	...	...	...	15	58
76	C Leicester and Northants Union	...	...	*See Grand Junction.*		
11	C Leven	...	...	...	3	26
130	C Liskeard	...	...	...	6	...
47	N Loughborough	...	...	...	9	20
23	C Louth	...	...	...	11	60
83	N Lower Avon	...	...	...	28	20
31	C Macclesfield	26	23	Great Central Railway Co.	...	...
21	C Manchester (Ship)	...	...	...	35	40
	The Bridgwater Canals, and the Mersey and Irwell Navigations	...	...	...	74	35 (Mls. Ch. 109 75)

19	C	Manchester and Bolton	15	60	Lanc. and York. Railway Co.	...	...
9	N	Market Weighton	...	...	...	9	5
107	N	Medway, Lower	...	...	...	7	...
107	N	Medway, Upper	...	...	...	16	...
	C	Middle Level	...	...	*See Ouse* (*Bedford*).		
90	C	Monmouthshire	19	63	Great Western Railway Co.	...	...
93	C	Neath	...	...	...	13	...
53	N	Nen	...	...	...	77	72
62	C	North Walsham and Dilham	...	...	...	8	40
65	N	Norwich and Lowestoft	30	...	Great Eastern Railway Co.	...	...
42	C	Nottingham	15	31	Great Northern Railway Co.	...	...
45	C	Nutbrook	...	...	...	4	40
51	N	Ouse (Bedford)	...	...	...	161	12
		And Connections— Miles. Chains.					
		Burwell Lode 3 2					
		Cam River 7 0					
		Middle Level 83 20					
		Ouse (St Ives) 4 70					
		South Level 63 0					
110	N	Ouse (Sussex)	...	...	...	6	40
4	N	Ouse (York)	...	...	...	43	...
77	C	Oxford	...	...	...	81	60
120	N	Parrett	...	...	...	25	...
30	C	Peak Forest	15	12	Great Central Railway Co.	...	...
43	C	Pinxton Branch	2	26	Midland Railway Co.	...	...
8	C	Pocklington	9	40	N.-E. Railway Co.	...	...
115	C	Portsmouth and Arundel	...	...	...	14	40
75	C	Regents	10	67	N. Metropolitan Railway Co.	...	...
135	N	Ribble	...	...	...	11	...
5	C	Ripon and Boroughbridge	10	20	N.-E. Railway Co.	...	...

ENGLAND AND WALES—*continued*

No. on Map.	Name.	Railway Controlled. Miles.	Railway Controlled. Chains.	Owners.	Independent. Miles.	Independent. Chains.
16	C Rochdale	...	...	...	34	44½
72	N Roding	...	...	...	3	...
84A	N Severn	...	...	...	43	20
84B	N Severn, above Stourport	...	...	...	40	...
84	N Severn, Lower	...	...	...	12	...
	N Sharpness New Docks and Gloucester and Birmingham Navigation	...	...	...	54	40
	N Sheffield and S. Yorkshire	...	...	...	59	49
	(Miles. / Chains.)					
	Sheffield Canal 3 / 72					
22	River Dun Navigation 29 / 2					
	Stainforth and Keadby Canal 12 / 57					
	Dearne and Dove Canal 13 / 78					
85	C Shropshire (Coal port)	2	4½	London and N.-W. Railway Co.	...	...
35	C Shropshire Union Railway and Canal Co.	...	...	...	200	67
	(Miles. / Chains.)					
	Birmingham and Liverpool 39 / 7					
	Chester Canal 19 / 15					
	Wirral Line 8 / 63					
	Newport Branch 11 / 6					
	Middlewick Branch 9 / 64					
	Ellesmere Canal 68 / 73					
	Montgomeryshire Canal 25 / 73					
	Shrewsbury Canal 18 / 6					

			Miles.	Chains.					
100		Gloucester and Berkeley Ship Canal	16	0					
81		Worcester and Birmingham Canal	30	0					
81		Droitwich Junction	1	60					
81		Droitwich	6	60					
37	C	Sleaford			...	...	...	13	...
103	C	Somerset Coal			...	...	...	10	43
51	C	South Level			...	...	*See Ouse.*		
59	C	Stafford and Worcester			...	...	...	51	...
32	C	Stockport			5	...	Great Central Railway Co.	...	...
74	C	Stort			...	...	...	13	41
69	N	Stour			...	...	...	25	...
60	C	Stourbridge			...	...	...	7	15
61	C	Stourbridge Extension			2	77	Great Western Railway Co.	...	...
126	C	Stover			1	68	Great Western Railway Co.	...	...
82	C	Stratford-on-Avon			25	50	Great Western Railway Co.	...	...
99	C	Stroudwater			...	...	...	7	70
131	C	St Columb			...	...	...	6	...
20	C	St Helens			16	65	London and N.-W. Railway Co.	...	...
109	C	Surrey			...	...	...	3	60
	C	Swaffham and Bottisham			...	...	...	9	60
95	C	Swansea and Trewyddfa			16	40	Great Western Railway Co.	...	...
129	C	Tavistock			...	...	...	4	...
97	N	Thames			...	...	...	145	...
98	C	Thames and Severn			...	...	...	30	10
134	N	Tees[1]			...	...	...	26	...
94	C	Tennant's			...	...	...	4	40

[1] *Tidal* only.

ENGLAND AND WALES—*continued*

No. on Map.		Name.	Railway Controlled. Miles.	Railway Controlled. Chains.	Owners.	Independent. Miles.	Independent. Chains.
127	N	Torridge	...	...	...	6	...
26	N	Trent	...	...	...	68	...
33	C	Trent and Mersey	119	3	N. Stafford Railway Co.	...	...
121	N	Tone	...	...	...	9	...
132	N	Tyne [1]	...	...	...	19	...
2	C	Ulverston (Ship)	1	30	Furness Railway Co.	...	...
137	N	Usk	...	...	...	9	...
79	C	Warwick and Birmingham	...	...	...	22	50
78	C	Warwick and Napton	...	...	...	14	20
66	N	Waveney	...	...	*See Great Yarmouth.*		
133	N	Wear [1]	...	...	...	9	...
34	N	Weaver	...	...	...	20	...
40	N	Welland	...	...	...	27	...
113	N	Wey	...	...	...	15	20
112	N	Wey and Arun	...	...	...	5	...
6	N	Wharfe	...	...	...	9	40
101	C	Wilts and Berks	...	...	...	69	...
52	C	Wisbech	...	...	...	5	20
36	N	Witham	31	52	Great Northern Railway Co.	...	...
114	C	Woking, Aldershot, and Basingstoke	...	...	...	37	40
81	C	Worcester and Birmingham	...	...	*See Sharpness New Docks.*		
88	N	Wye	...	...	...	99	...
64	N	Yare	...	...	*See Great Yarmouth.*		
		Total, England and Wales	978	24¼		2691	50

[1] *Tidal* only.

SCOTLAND

No. on Map.	Name.	Railway Controlled.		Owners.	Independent.	
		Miles.	Chains.		Miles.	Chains.
7	C Caledonian	...	...	...	60	40
8	C Crinan	...	...	...	9	...
2	N Clyde	...	...	...	19	...
12	N Dee (Aberdeen)	...	...	...	2	...
13	N Dee (Kirkcudbright)	...	...	...	8	40
4	C Edinburgh and Glasgow Union	31	53	North British Railway Co.	...	...
14	C Forth and Clyde	38	74	Caledonian Railway Co.	...	...
11	N Forth	...	...	...	56	60
3	C Monkland	13	14	Caledonian Railway Co.	...	...
10	N Tay	...	...	...	95	...
9	N Tweed	...	...	...	7	...
	Total, Scotland	84	25		257	60

[IRELAND.

IRELAND

No. on Map.	Name.	Railway Controlled. Miles.	Railway Controlled. Chains.	Owners.	Independent. Miles.	Independent. Chains.
2	N Bann (Upper)	...	...	...	7	40
1	N Bann (Lower)	...	...	...	32	...
3	N Barrow	...	...	...	43	...
5	N Boyne (Upper)	...	...	...	7	38
4	N Boyne (Lower)	...	...	...	12	63
6	C Coalisland	...	...	...	4	40
7	C Grand	...	...	...	209	18
8	N Lagan	...	...	...	26	20
9	N Maigue[1]	...	...	...	8	69
10	N Newry	...	...	...	18	...
11	C Royal	95	69	Midland G. W. Railway Co.	...	...
12	N Shannon	...	...	...	131	40
13	N Strabane	...	...	...	4	5
14	N Suir[1]	...	...	...	19	40
15	N Tyrone	...	...	...	4	31
16	C Ulster	...	...	...	46	...
	Total, Ireland	95	69	...	575	4
	Total, United Kingdom	1158	38¼	...	3524	34
	Grand Total (Canals and Navigations not belonging, and belonging, to Railway Companies)				4682	72¼

[1] *Tidal* only.

II.—ALPHABETICAL LIST OF CANALS AND NAVIGATIONS IN THE UNITED KINGDOM THAT HAVE BECOME DERELICT OR ARE CONVERTED INTO RAILWAYS.

Compiled from Lists given by Mr Lloyd in Appendix II, pp. 206-9, and by Mr Taunton in Appendix VII., pp. 225-7, of the Report of the Select Committee on Canals, 1883; and by Mr Wells in his Map of Canals and Navigable Rivers in England and Wales.[1]

D = Derelict; CR = Converted into Railways.

Name.	Miles.	Chains.	No. on Map.
D Aberdeenshire Canal . . .	19	...	1
CR Alford Canal	6	40	...
CR Andover Canal	22	40	117
D Avon, Lower	16	2	83
D Basingstoke Canal	37	40	114
D Baybridge Canal	3	40	111A
D Ballinamore and Ballyconnel Canal .	38	46	17
D Combe Hill Canal	3	...	84B
CR Carlisle Canal	11	40	1
CR Croydon Canal	9	40	109
D Gloucester and Hereford Canal .	34	...	87
CR Glastonbury Canal	14	...	119
D Glasgow and Paisley Canal . .	12	...	5
D Glenkenns Canal	27	...	6
D Grand Military Canal . . .	30	...	106
D Grand Western Canal . . .	25	...	124
D Gresley's Canal	9	...	33A
D Grosvenor Canal	1	...	...
D Horncastle Canal	11	...	38
D Kensington Canal	2	...	75A
CR Kidwelly Canal	3	40	96
D Kington, Leominster, and Stourport Canal	20	...	86
D Lough Corrib Navigation . . .	23	60	18
D Melton-Mowbray Canal . . .	14	60	...
D Nar River	15	...	50
CR Newport Pagnell Canal . . .	4	...	76A
D Oakham Canal and Wreak Navigation	26	...	48
D Portsmouth and Arundel Canal .	12	...	115
D Tavistock Canal	2	...	129
D Thames and Medway Canal . .	9	...	108
D Tiverton Canal	13	...	124
D Trent River	16	...	26A
CR Trent and Mersey Canal (part) . .	12	20	33
D Welland River (part)	27	...	40
D Wye Navigation (part) . . .	62	...	88
D Wey and Arun Canal . . .	15	...	112

[1] *Cf.* an interesting article on this subject in the *Globe* newspaper of 29th October 1904.

SUMMARY

	Mls.	Ch.
Total derelict, England and Wales	403	62
Total derelict, Scotland	58	0
Total derelict, Ireland	62	26
Total converted into Railways	83	60
Grand total derelict and converted into Railways .	607	68

III.—SUMMARY TABLE, showing the Mileage, Capital, Revenue, Traffic, Expenditure, and Nett Profit of the Canals and River Navigations of the United Kingdom.[1]

	Length.		Total Capital Paid-up and Raised from all Sources.	Total Revenue.	Traffic. Tons.	Expenditure.	Nett Profit.
	Miles.	Chains.					
Independent Canals and Navigations.							
England and Wales .	2,230	2	£35,091,403½	£1,895,506	32,513,800½	£1,322,201	£573,305
Scotland . . .	69	40	1,254,047	14,640	158,739	13,316	1,324
Ireland . . .	490	43	1,583,829	108,148	676,034	84,517	23,631
Total, U.K. . .	2,790	5	£37,929,279½	£2,018,294	33,348,573½	£1,420,034	£598,260
Canals and Navigations belonging to Railway Companies.							
England and Wales .	959	14½	[2]	£331,305	4,913,085½	£309,025	£22,280
Scotland . . .	83	61	[2]	52,369	1,064,595	28,830	23,539
Ireland . . .	95	69	[2]	6,566	32,140½	6,148	418
Total, U.K. . .	1,138	64¼	[2]	£390,240	6,009,820¾	£344,003	46,237
Grand total . .	3,928	69¼	[2]	£2,408,534	39,358,394¼	£1,764,037	£644,497

[1] *Cf.* Returns of the Board of Trade under sec. 39, sub-sec. 2, of the Railway and Canal Traffic Act 1888, for the year 1898.
[2] Capital is not distinguished in the accounts of the railway companies.

APPENDIX III

CHRONOLOGICAL LIST of Statutes, Charters, Grants, and Letters Patent relating to Rivers referred to.

The figures after each entry in last column indicate the pages of text where subject is referred to.

I.—ENGLAND AND WALES

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1225	9 Hen. III. [Magna Charta]	All rivers, 3, 4, 25, 28, 30, 52, 83.
1393	17 Ric. II. c. 9 . . .	Thames and all rivers, 47, 161.
1399	1 Hen. IV. c. 12 . .	All rivers, 28, 52.
1423	2 Hen. VI. c. 9 . . .	Thames, 47.
1423	2 Hen. VI. c. 15 . .	Thames, 47.
1424	3 Hen. VI. c. 6 . . .	Lea, 50, 51.
1430	9 Hen. VI. c. 5 . . .	Severn, 48.
1462	Charter of Conservancy [2 Ed. IV.] to Mayor and Burgesses of York . .	Aire, Derwent, and Calder, 4.
1472	12 Ed. IV. c. 7 . . .	All rivers, 50.
1503	19 Hen. VII. c. 18 . .	Severn, 52.
1514	6 Hen. VIII. c. 17 . .	Stour [Kent], 48.
1514	Charter to Watermen's and Lightermen's Company [6 Hen. VIII.] . .	Thames, 51, 61.
1529	21 Hen. VIII. c. 6 . .	Tyne, 66, 172, 175.
1531	23 Hen. VIII. c. 18 . .	Yorkshire, Ouse, & Humber, 51, 61.
1539	31 Hen. VIII. c. 4 . .	Exe, 51.
1542	34 and 35 Hen. VIII. c. 9 .	Avon [Somerset], 51, 61, 96.
1566	8 Eliz. c. 13 . . .	Trinity House, 49.
1571	13 Eliz. c. 18 . . .	Lea, 61, 62, 175.
1617	Letters Patent, 21st July, to John Gasson [15 Jas. I.].	Locks in rivers, 69.
1618	Letters Patent, 16th July, to John Gilbert [16 Jas. I.].	Dredgers in rivers, 70.
1624	21 Jas. I., c. 32 . . .	Thames, 47, 64, 159, 160.
1631	Letters Patent, 1st July, to John Gilbert and Jas. Feese [6 Car. I.] . .	Dredgers in rivers, 70.
1634	Crown Grant [9 Car. I.] to Thomas Skipwith . .	To render navigable the Soar, 71.
1636	Crown Grant [11 Car. I.] to William Sandys . .	To render navigable the Avon [Warwick], 71.

ENGLAND AND WALES—*continued*

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1637	Proclamation [11 Car. I.] .	"Cleansing the river Thames of shelves and annoyances," 70.
1662	13 and 14 Car. II. c. 2 .	Port of London, 163.
1662	13 and 14 Car. II. c. 13 .	Stower and Salwey, 76.
1662	13 and 14 Car. II. c. 14 .	Wye and Lugg, 77.
1664	16 and 17 Car. II. c. 6 .	River between Bristow-Cawsey and Thames, 79.
1664	16 and 17 Car. II. c. 11 .	Avon [Hants], 78, 81.
1664	16 and 17 Car. II. c. 12 .	Medway, 81.
1664	16 and 17 Car. II. c. 13 .	Divers rivers: — Itchen, Test, Mole, and Great Ouse, 79.
1665	Letters Patent [17 Car. II.] to Trinity House . .	Ballasting of vessels, etc., between London Bridge and the sea, 175.
1669	22 Car. II. c. 16 . .	Brandon and Waveney, 80.
1671	23 and 24 Car. II. c. 25 .	River between Boston and Trent, 80.
1671	23 and 24 Car. II. c. 26 .	Wey, 80.
1678	30 Car. II. c. 20. . .	Fal or Vale, 80.
1685	Grant [1 Jas. II.] to Trinity House	Confirming and enlarging powers as to lighting, etc., 176.
1695	7 and 8 Will. III. c. 14 .	Wye and Lugg, 78.
1698	10 and 11 Will. III. c. 8 .	Calder, 80, 82.
1698	10 and 11 Will. III. c. 19 .	Tone, 80.
1698	10 and 11 Will. III. c. 20 .	Trent, 80.
1700	11 and 12 Will. III. c. 24 .	Dee, 80.
1700	11 and 12 Will. III. c. 24 .	Larke, 80.
1702	1 Anne c. 11 . . .	Cam, 80.
1702	1 Anne c. 20 . . .	Derwent [Yorks], 80.
1711	10 Anne c. 8 . . .	Avon [Somerset], 80.
1713	12 Anne c. 2 . . .	Nen, 80.
1714	1 Geo. I. c. 24 . . .	Kennett, 80.
1716	3 Geo. I. c. 20 . . .	Don, 80.
1716	3 Geo. I. c. 35 . . .	Kennett, 80.
1719	6 Geo. I. c. 9 . . .	Don, 80.
1719	6 Geo. I. c. 25 . . .	Douglas, 80.
1719	6 Geo. I. c. 27 . . .	Derwent [Derby], 80.
1720	7 Geo. I. c. 8 . . .	Kennett, 80.
1720	7 Geo. I. c. 10 . . .	Weaver, 80, 154.
1720	7 Geo. I. c. 15 . . .	Mersey, 80, 85.
1721	8 Geo. I. c. 14 . . .	Eden, 80.
1725	12 Geo. I. c. 38 . . .	Don, 80.
1726	13 Geo. I. c. 11 . . .	Don, 80.
1734	7 Geo. II. c. 28 . . .	Weaver, 80, 154.
1741	14 Geo. II. c. 26 . .	Medway, 81, 82.
1751	24 Geo. II. c. 8 . . .	Thames, 47, 160.
1751	24 Geo. II. c. 39 . .	Avon [Warwick], 73.

ENGLAND AND WALES—*continued*

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1759	33 Geo. II. c. 49 . .	Weaver, 154.
1766	6 Geo. III. c. 94 . .	Soar, 71.
1771	11 Geo. III. c. 45 . .	Thames, 160.
1773	14 Geo. III. c. 91 . .	Thames, 160, 161.
1774	15 Geo. III. c. 11 . .	Thames, 160, 162.
1775	16 Geo. III. c. 5 . .	Soar, 71.
1776	17 Geo. III. c. 18 . .	Thames, 161.
1788	28 Geo. III. c. 51 . .	Thames, 160, 162.
1790	30 Geo. III. c. 52 . .	Ouse [Sussex], 45.
1790	30 Geo. III. c. 75 . .	Severn, 156.
1792	32 Geo. III. c. 105 . .	Medway, 81.
1795	35 Geo. III. c. 106 . .	Thames, 160.
1798	39 Geo. III. c. 119 . .	Port of London, 163.
1799	40 Geo. III. c. 54 . .	Ouse [Sussex], 54.
1802	42 Geo. III. c. xlix. . .	Thames, 163.
1802	42 Geo. III. c. 94 . .	Medway, 81.
1803	43 Geo. III. c. lxiii. . .	Port of London, 163.
1805	45 Geo. III. c. xxxi. . .	Port of London, 163.
1806	46 Geo. III. c. 122 . .	Port of London, 163.
1807	47 Geo. III. c. 49 . .	Weaver, 154.
1807	47 Geo. III. c. cxvii. . .	Adur, 167.
1807	47 Geo. III. c. 129 . .	Avon [Somerset], 80.
1808	48 Geo. III. c. xlviii. . .	Tees, 151.
1809	49 Geo. III. c. 78 . .	Wye and Lugg, 78.
1809	49 Geo. III. c. xli. . .	Wear, 151.
1811	51 Geo. III. c. 167 . .	Avon [Somerset], 80.
1812	52 Geo. III. c. xlvii. . .	Thames, 160.
1812	52 Geo. III. c. 45 . .	Port of London, 163.
1814	54 Geo. III. c. 223 . .	Port of London, 163.
1824	5 Geo. IV. c. xcvi. . .	Welland, 150.
1824	5 Geo. IV. c. 123 . .	Port of London, 150.
1824	5 Geo. IV. c. 148 . .	Medway, 163.
1825	7 Geo. IV. c. 29 . .	Weaver, 154.
1825	7 and 8 Geo. IV. c. lxxv. .	Watermen's and Lightermen's Company, 173.
1829	10 Geo. IV. c. 70 . .	Weaver, 154.
1829	10 Geo. IV. c. cxiv. . .	Port of London, 163.
1834	4 and 5 Will. IV. c. 32 .	Port of London, 163.
1842	5 and 6 Vict. c. 1 . .	Port of London, 163.
1842	5 and 6 Vict. c. 24 . .	Severn, 157.
1844	7 and 8 Vict. c. 10 . .	Severn, 157.
1845	8 and 9 Vict. c. 1 . .	Thames, 163.
1845	8 and 9 Vict. c. 86 . .	Port of London, 157.
1845	8 and 9 Vict. c. 184 . .	Severn, 157.
1846	9 and 10 Vict. c. 291 . .	Severn, 157.
1849	12 and 13 Vict. c. 90 . .	Port of London, 163.
1850	13 and 14 Vict. c. cix. .	Lea, 63.

ENGLAND AND WALES—*continued*

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1851	14 and 15 Vict. c. cxxxvi. .	Welland, 150.
1858	21 and 22 Vict. c. 147 .	Thames, 166.
1859	22 and 23 Vict. c. xxxiii. .	Watermen's and Lightermen's Company, 173.
1864	27 and 28 Vict. c. 113 .	Thames, 166.
1866	29 and 30 Vict. c. 89. .	Thames, 166.
1868	31 and 32 Vict. c. 154 .	Lea, 63.
1869	32 and 33 Vict. c. xviii. .	Usk, 151.
1870	33 and 34 Vict. c. 149 .	Thames, 166.
1877	40 and 41 Vict. c. xl.. .	Wear, 151.
1878	41 and 42 Vict. c. ccxvi. .	Thames, 166.
1883	46 and 47 Vict. c. lxxix. .	Thames, 166.
1885	48 and 49 Vict. c. 76. .	Thames, 167.
1889	52 and 53 Vict. c. cxxiii. .	Ribble, 151.
1892	55 and 56 Vict. c. xxvii. .	Tees, 151.
1893	56 and 57 Vict. c. xxvi. .	Usk, 151.
1894	57 and 58 Vict. c. clxxxvii.	Thames, 170, 172, 173.
1905	5 Ed. VII. c. cxc. . .	Thames, 165.

II.—IRELAND

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1715	2 Geo. I.	Shannon, Liffey, Rye, Boyne, Barrow, Bann, Foyle, Earn, and many other rivers, 181.
1729	3 Geo. II.	Appointing commissioners to carry out Act of 1715, 182.
1751	25 Geo. II. c. 10. . .	Creating commissioners a corporation for promoting inland navigation in Ireland, 183.
1787	27 Geo. III. c. 30 . .	Dissolving corporation, and vesting navigations in various local corporations and companies, 183.
1800	40 Geo. III. c. 51 . .	Appointing the directors of inland navigation, 185.
1826	6 Geo. IV. c. 193 . .	Ulster Canal, 192.
1831	2 Will. IV. c. 33 . .	Transferring powers of directors to Board of Works, 186, 194.
1835	5 and 6 Will. IV. c. 67 .	Shannon, 195.
1839	2 and 3 Vict. c. 61 . .	Shannon, 195.
1846	9 and 10 Vict. c. 98 . .	Shannon, 195.
1874	37 and 38 Vict. c. 60 . .	Shannon, 195.

III.—SCOTLAND

Year.	Statute, Charter, Grant, or Letters Patent.	Subject.
1759	32 Geo. II. c. 62 . .	Clyde, 199, 203.
1769	10 Geo. III. c. 104 . .	Clyde, 199.
1808	48 Geo. III. c. civ. . .	Tweed [Berwick Harbour], 198.
1809	49 Geo. III. c. 74 . .	Clyde, 198.
1810	50 Geo. III. c. lxx. . .	Dee [Aberdeen Harbour], 201.
1825	6 Geo. IV. c. 117 . .	Clyde, 199.
1830	11 Geo. IV. and 1 Will. IV. c. cxxi.	Tay, 198.
1840	3 and 4 Vict. c. 118 . .	Clyde, 199.
1846	9 and 10 Vict. c. 23 . .	Clyde, 199.
1849	12 and 13 Vict. c. xxiii. .	Tay, 198.
1862	25 and 26 Vict. c. xxxi. .	Tweed [Berwick Harbour], 198.
1872	35 and 36 Vict. c. ix. . .	Tweed [Berwick Harbour], 198.
1873	36 and 37 Vict. c. xlvii. .	Forth, 203.
1875	38 and 39 Vict. c. cl. . .	Tay, 198.
1887	50 and 51 Vict. c. lxxiv. .	Dee [Aberdeen Harbour], 201.

APPENDIX IV

COMMISSIONERS OF SEWERS

REFERENCE has been made in Chap. III. of this work to the fact that the earliest form of conservancy authority for navigation was the delegation, in 1427 by 6 Hen. vi. c. 3, of the Crown prerogatives in this respect to Commissions of Sewers; and it was pointed out that the term *sewer*, which in later times has acquired a more restricted application, was probably a diminutive of *river*, and that the powers and functions of these commissions were therefore principally concerned with defensive works against inundation from the sea or from navigable rivers, obstructions to navigation, navigable rivers, water courses, streams, pools, and gutters. It was also shown that the Commissions, at first issued from time to time as need required in the particular districts for which they were appointed, were by a late Act in 1861 made permanent when once issued, but that the greater part of their functions have now been transferred by legislation to various corporate bodies of modern growth—except in the vicinity of the seacoast, and of such navigable rivers as are not under any conservancy authority. It may be of interest therefore to show, from contemporary records, that, in certain localities, these Commissions, which appear to be the only conservancy authorities invested with powers for the prevention of floods, still survive, and that a great deal of highly necessary work is now unobtrusively performed by bodies whose original representatives may have fought in the Wars of the Roses, and some of whose officials to this day retain titles of distinctly medieval flavour. We extract from the *East Sussex News* of June 10, 1904, a few details of the annual meeting of the Commissioners of Sewers for the Lewes and Laughton Levels, headed Lewes Watercourt.

Captain S—— presided, and there were present nine other Commissioners including the "expenditor." The annual report commented on the exceptionally heavy rainfall of the past year (1903), notwithstanding which no very serious floods had occurred. The effect, however, of such large quantities of water being out had been to severely scour the banks in places in the fifth district and in Mighell's Cut at Hamsey. The tidal wave which occurred on February 3rd caused an overflow of the banks in Beddingham parish, and the same thing occurred, to a greater extent, in Mighell's Cut, where 24 tons of chalk were required to repair the damage. The Commissioners' works generally were in good condition, with the exception of Edlee Sluice, where some repairs were required to doors and wings. The committee observed that in Seaford Bay the inner face of the sea wall near the Buckle Inn had been a good deal washed out by the sea, but the Sea Defence Commissioners were repairing with faggots. The committee thought the Sea Defence Commissioners do wrong in digging out the earth at the back of the sea wall. The trustees of the Newhaven Harbour and Ouse Lower Navigation had notified that £147—one-fourth of the annual sum of £588 authorised by the Act of 1847—was required to be raised for the current year; and the Court was recommended to make the usual order on the trustees to expend the sum of £9 out of the navigation "scot" on work to the river in District 4. A general "scot" of 8d. per acre was recommended.

The chairman said that when the Commissioners visited Newhaven they had noticed that the Sea Defence Commissioners still continued the objectionable practice of digging out the earth at the back of the defences to put on the defences; and they advised that a letter be written, calling attention to the practice, and asking that it be discontinued, as they had a right to do, since they contributed £100 to the maintenance of these works. The report was adopted, and the clerk directed to write accordingly to the Commissioners of the Seaford Defences. The jury of seventeen, who had been sworn at the commencement of the proceedings, made their "presentment," calling attention to the condition of Bridger's Cut from Sluice No. 18 in the third district of the river, which obstructed the drainage of certain lands. They asked the Court whether there was a public right of way on the banks of Glynde Ritch, which was

used for shooting purposes, and also called attention to the Great Sluice and Auxiliary Sluice at Rodmell with a view to regulating the drainage of land in the Kingston and Rodmell levels. The jury retired, and, after discussion, action was taken on their "presentment," and the Court adjourned.

It will be evident from this summary of the proceedings of a modern "watercourt," that the powers of Commissioners of Sewers comprise (1) those of surveying defences against the sea, and obstructions to navigation or the flow of rivers in their districts, and determining through whose default any damage to defences or obstructions were due; (2) of assessing the lands of all individuals in their district for such repairs as may be necessary; and (3) of making such ordinances and decrees as may be expedient for this purpose. It may be added that by the judicial authority with which they are invested, they may sit in judgment on their own orders, subject to the correction of the higher courts and may issue writs and precepts to sheriffs, bailiffs, and others, and may punish by distress, fine, and sometimes imprisonment, persons neglecting or disobeying such orders.[1]

The report of the House of Lord's Committee, 1877 (Appendix) gives the Commissions of Sewers then in force as thirty-one under 23 Henry III. c. 5; twelve under Part I. of the Land Drainage Act, 1861; and twenty-nine "separate drainage districts" under the latter Act, giving a total of seventy-two. Lists of the several places having Commissions of Sewers will also be found in Part VI. of the Local Taxation Returns, those for 1902-3 being the latest.

[1] See *Law of Waters*, 2nd edition, pp. 32-33.

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[*The references are to the foot notes at the pages indicated.*]

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